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PANAMA CANAL ELECTRIC TOWING SYSTEM.

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BY JOHN CARRELL.

THE BEST CONTROL OF PUBLIC UTILITIES.
BY FRANK G. BAUM.

INDUCTIVE INTERFERENCE.

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Alphabetical Index to Advertisers, Page 8 **Where to Buy It in the West, Page 7**

Anchor to

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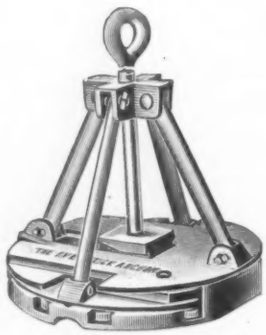

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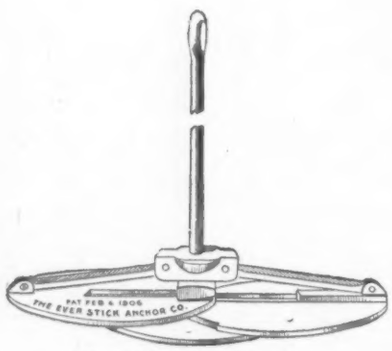
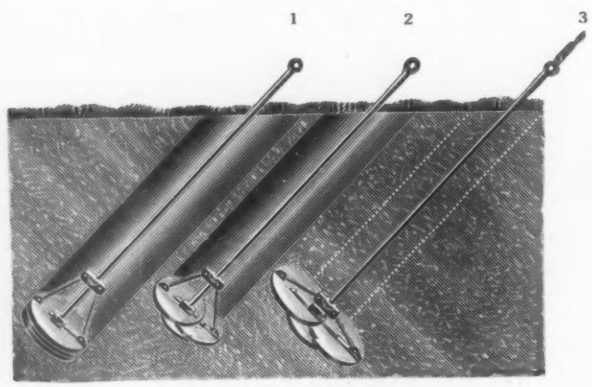


Everstick Anchor Expanded



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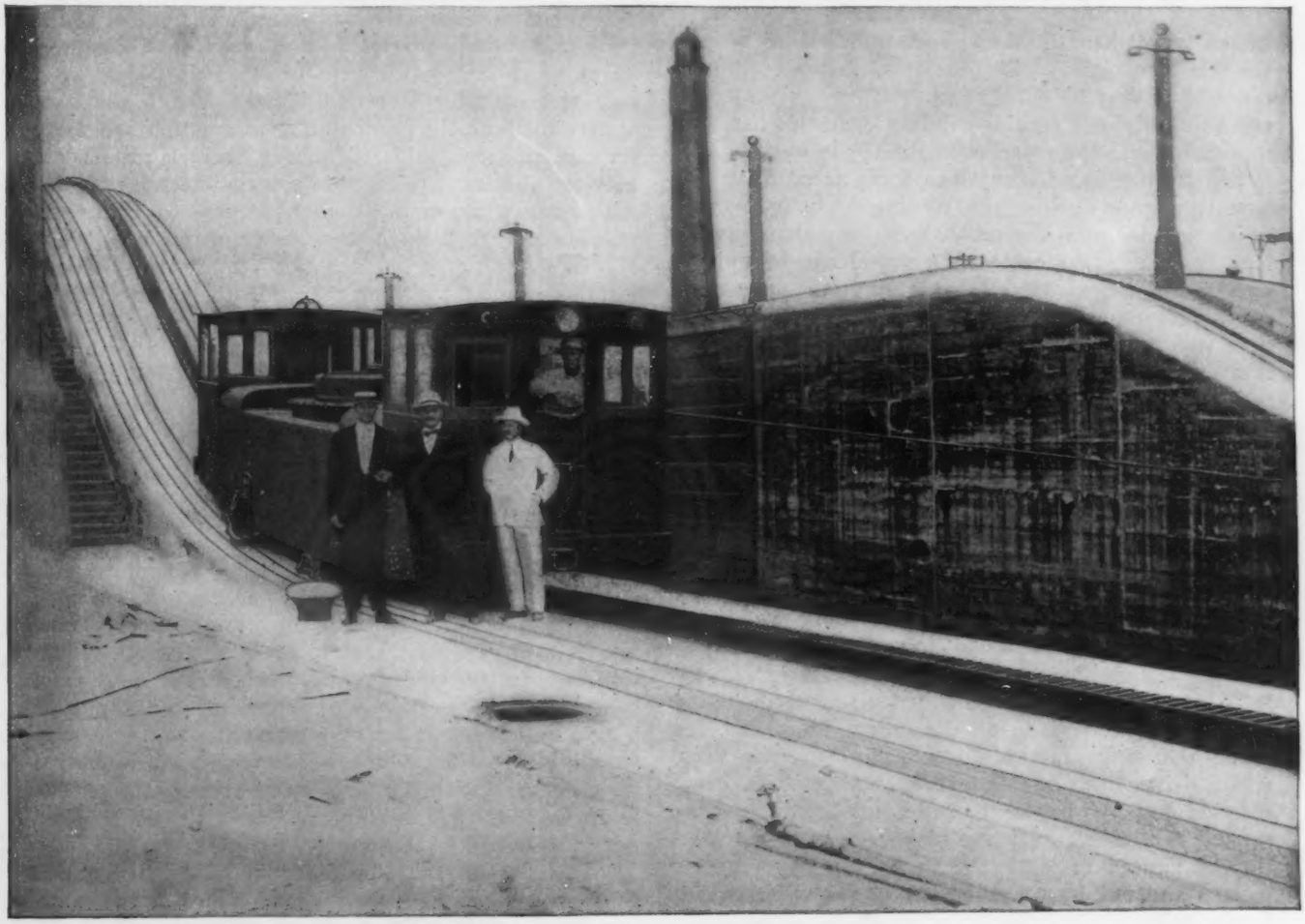
PANAMA CANAL ELECTRIC TOWING SYSTEM

In passing through the Canal from the Atlantic to the Pacific, a vessel will enter the approach channel in Limon Bay, which extends to Gatun, a distance of about 7 miles. At Gatun it will enter a series of three locks in flight and be raised 85 feet to the level of Gatun Lake. It may then steam at full speed through the channel in this lake, for a distance of 24 miles, to Bas Obispo, where it will enter the Culebra Cut. It will pass through this cut, which has a length of nine miles, and reach Pedro Miguel, where it will enter a lock and be lowered 30 ft. Then it will pass through Miraflores Lake for a distance of 1½ miles until it reaches Miraflores, where it will be lowered 55 feet through two locks, to the sea level, after which it passes out into the Pacific through an 8½ mile channel.



Towing Locomotive About to Ascend the Incline Leading to the Top Level of Gatun Locks. Standing in the Foreground, Left to Right, are: Edward Schildhauer, Electrician and Mechanical Engineer, Isthmian Canal Commission (I. C. C.); Lt. Col. William L. Sibert, Isthmian Canal Commissioner and Atlantic Division Engineer; C. W. Larson, Industrial Locomotive Designing Engineer, General Electric Company.

The main features of all the lock sites are identical; and the following brief description of the Gatun Locks, with special reference to the arrangement of the towing tracks, ship channels, inclines and ap-

proaches, is given to enable the reader to obtain a clearer conception of the towing scheme in general, as well as the more detailed dscription of the locomotive which is to follow.

The Gatun Locks has two ship channels, one for traffic in each direction. The channels are separated by a center wall, the total length of which is 6330 ft. There are two systems of tracks, one for towing and the other for the return of the locomotive when returning idle. This, however, refers only to the outer walls. For the center wall, there is only one return track in common for both the towing tracks. The towing tracks are naturally placed next to the channel side, and the system of towing utilizes normally not less than four locomotives running along the lock walls. Two of them are opposite each other in advance of the vessel, and two run opposite each other following the vessel. The number of locomotives is, however, increased when the tonnage of the ship demands it.

Cables extend from the forward locomotives and connect with the port and starboard sides respectively of the vessel near the bow, and other cables connect the rear locomotives with the port and starboard quarters of the vessel. The lengths of the various cables are adjusted by a special winding drum on the locomotive to place the vessel substantially in mid-channel. When the leading locomotives are started, they will tow the vessel; while the trailing locomotives will follow and keep all the cables taut. By changing the lengths of the rear cables, the vessel can be guided; and to stop the vessel, all the locomotives are slowed down and stopped, thus bringing the rear locomotives in action to retard the ship. Therefore, the vessel is always under complete control quite independent of its own power, and the danger of injury to the lock walls and gates is very greatly lessened.

The towing tracks have a specially designed rack rail extending the entire length of the track and located centrally with respect to the running rails. It is through this rack rail that the locomotive exerts the traction necessary for propelling large ships and climbing the steep inclines.

A rack rail is also provided on short portions of the return track so as to lower the locomotives safely from one level to the next. The steepest slope is 26 degrees or 44 per cent, hence the need will be seen for rack rail even on the return track, it being noted that any traction locomotive with the usual wheel drive, even with the brakes set, would begin to slide on a 16 per cent grade and therefore could not be controlled. With a rack rail, however, traction is limited only by the capacity of the driving motors and not by the adhesion of the wheel treads on the rails.

Locomotive Design.

The working parts of the locomotive are supported by two longitudinal upright side frames No. 1, Fig. 1, of cast steel, connected by transverse beams No. 2, Fig. 2. These frames are in effect deep, rigid trusses, having upper and lower members connected by posts No. 5 and diagonal braces, No. 6, Fig. 1. The middle portion of each frame has its upper and lower numbers parallel and horizontal, but the end portions have their lower members inclined upwardly towards the ends of the frame. The pedestals, No. 7, for the wheel axles, No. 8 are located at the junction of these end portions with the middle portion, and are of the usual locomotive type, having vertical parallel jaws between which the journal, No. 9, slides. Springs, No. 10, are interposed between the tops of the journal boxes and the tops of the pedestals, and the locomotive is thus mounted upon four wheels, No. 11, carried on the two axles, No. 8, the wheelbase being 12 feet, and the overall length of the locomotive over 32 feet.

Each axle is driven by its own motor, independent of the other. The motor is of the three-phase, slip-ring type, enclosed and identical to the rugged steel mill design; and it is geared by a pinion and spur gear to the countershaft. When the clutch teeth are engaged, the motor will propel the locomotive by the adhesion between the wheels, No. 11, and the rails of the track, and this only when running without load and between inclines.

When the locomotive, however, reaches one of the inclines between the locks, the grade of which may be as much as 44 per cent, or when it is towing a ship, the cog rail system is utilized to enable the locomotive to climb the grade and exert traction necessary for pulling large ships. The cog or rack rail is laid between the track rails; and the locomotive is provided with a cog wheel or rack pinion, secured to or integral with a sleeve, which rotates freely on the axle.

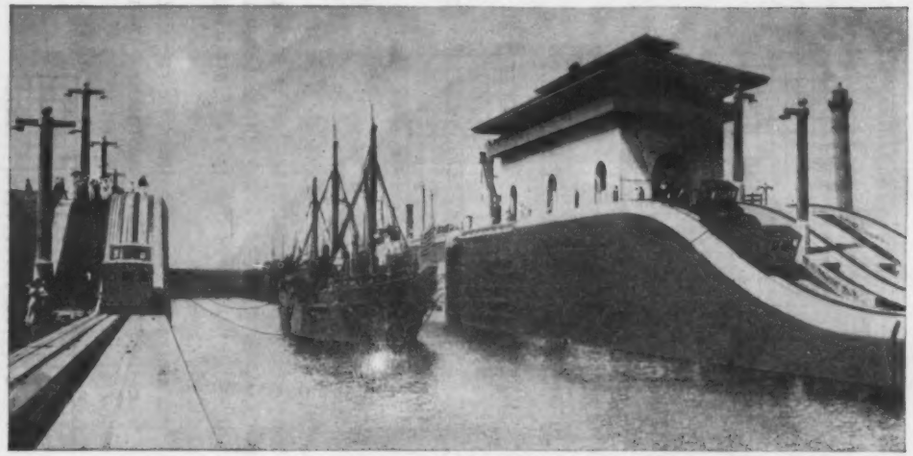
In connection with each motor a powerful brake is installed; and, as during operation the motors are at all times geared either to the axles or to the cog wheels, the truck wheels, are not provided with any brake rigging. The motor brake is clearly illustrated in Fig. 3.

A motor-driven windlass with which each locomotive is equipped, as illustrated in Fig. 4, is used for handling the towing cable. One motor with bevel gear pinion is used for driving the drum at a high speed when coiling the cable that has been cast off, and it remains permanently in gear. The other motor, with worm gear drive is used for taking in the cable when it is under load, and the drum operates as a windlass or capstan. Due to the greater gear reduction, it operates the drum at a much slower speed; and consequently, with motors of approximately equal size, a greater force may be exerted on the tow line than would be possible with the lower speed reduction which is used with the high speed coiling motor. The worm gear drive is disconnected from the drum when not in use.

In order to resist the tendency of the locomotive to tip over when an excessive load comes on the cable, a stout rack rail, laid between the traction rails of the track, and two horizontal flanged wheels, are arranged between each pair of wheels, to engage the opposite sides of the rack. Their outer ends are engaged by strong springs, No. 139, which afford the necessary flexibility for smooth operation.

The rapid coiling motor is permanently geared to the drum and is of the same type, size and capacity as the winding motor. It is subjected to its maximum load when accelerating the heavy drum to the high speed required for coiling or paying out the rope, this

Towing Locomotives on First Trial Run, Returning Barge Through Gatun Locks to Atlantic Level, Panama Canal.



U. S. Tender Severn Leaving Upper East Chamber in Tow of Electric Locomotives, April 15, 1914.

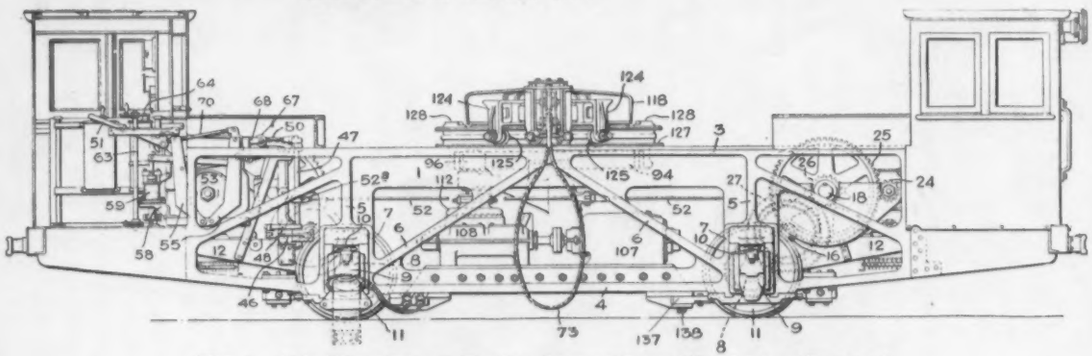


Fig. 1. Side Elevation of Towing Locomotive with Covers Removed.

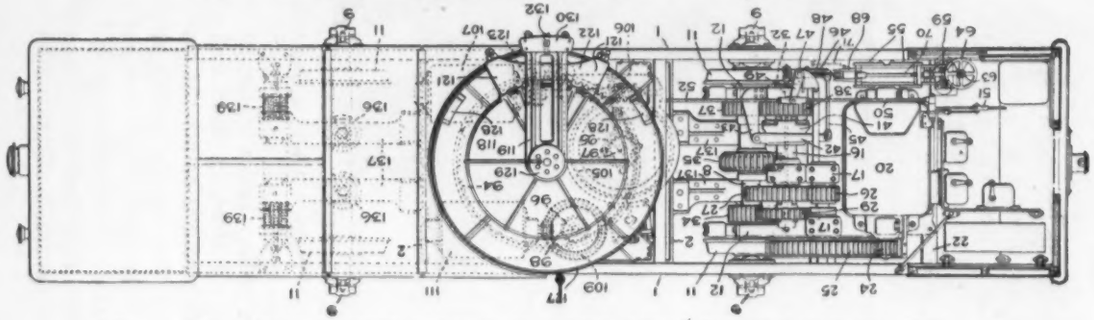


Fig. 2. Plan View of Towing Locomotive with Covers Removed from One End.

Steamship Ancon Entering Upper Lock From Middle West Chamber Under Tow of Electric Locomotives, Looking South from Balcony of Control House, June 11, 1914.

being sixteen times the slow winding speed at full load, or about 200 feet per minute.

The slow winding and the rapid coiling motors are operated by similar controllers and the circuits electrically interlocked so as to prohibit application of power to either motor unless the controller of the other motor is in the "off" position.

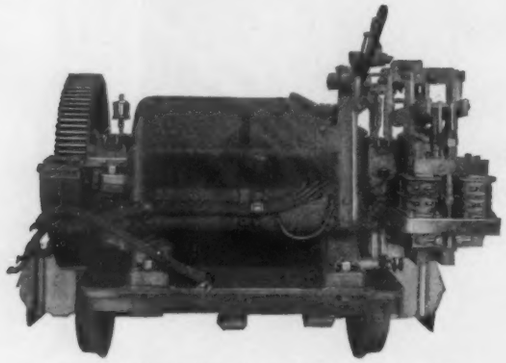


Fig. 3. Rear View of Traction Motor Unit.

Each of the two main traction motors has a rating of 75 h.p., and is of the slip ring induction type, operated by a system of contactors with master controller in each cab. The motors, by means of the change in gearing from straight traction to rack rail towing, drive the locomotive at a speed of two miles per hour when towing and 5 miles per hour when returning idle. These motors act as induction generators running above synchronous speed when the locomotive is passing down the steep inclines and thereby exert a

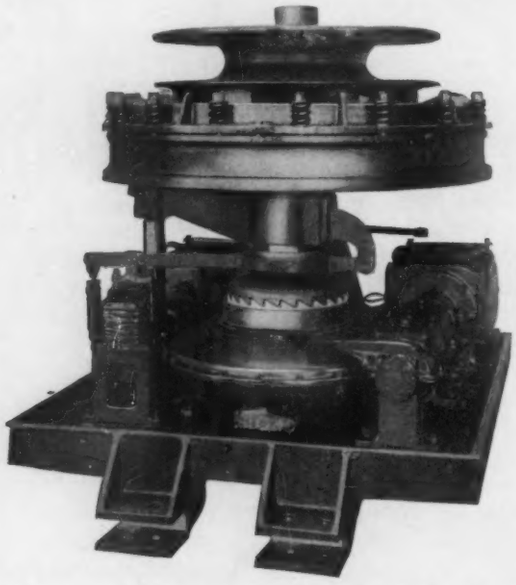


Fig. 4. Windlass and Base Assembled Complete.

retarding brake effect to keep the speed uniform. Speed tractive effort and efficiency tests were made with results as per the curves in Fig. 5.

The curves in Fig. 6 give some interesting data on the time of acceleration of ships in the lock chambers. These values have been obtained from certain tests and theoretical calculations based on data given by several well known authorities.

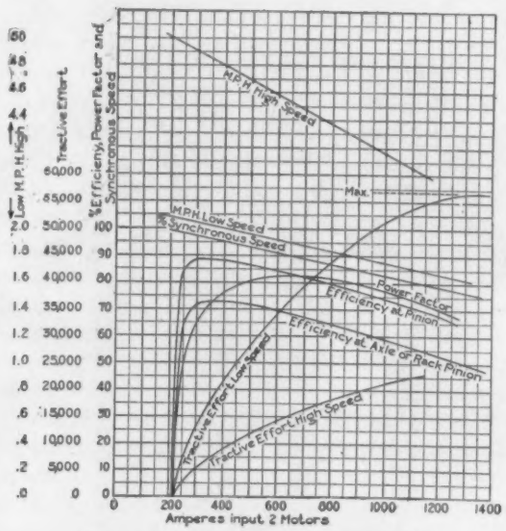


Fig. 5. Curves of Traction Tests.

Summary.

The towing locomotives as described and illustrated possess the following operating characteristics:

1—While towing, the speed can be regulated from zero miles to two miles per hour.

2—While running idle, the speed can be regulated from zero to five miles per hour, permitting return trips at increased speed.

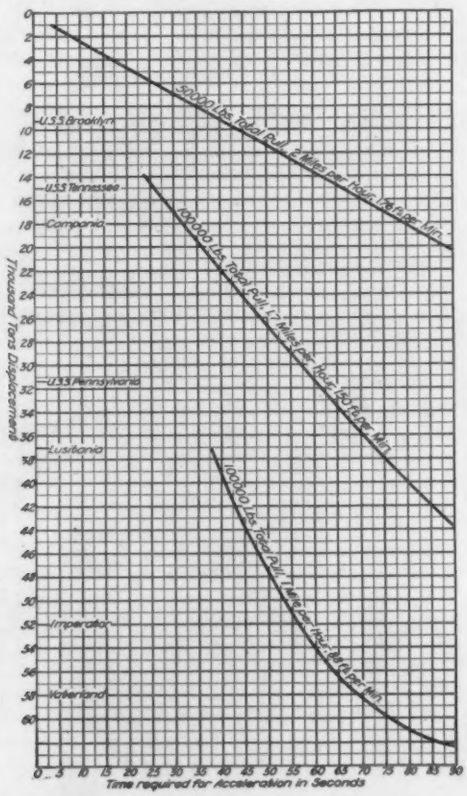


Fig. 6. Curves Showing the Time Required for the Acceleration of Ships.

3—The windlass will pay out or wind in cable at the low rope speed and at the full tow line pull of 25,000 lb. either when the locomotive is running or at rest.

4—The windlass will pay out or coil in cable at the high rope speed with the tow line taut, either when the locomotive is running or at rest.

5—The windlass is equipped with a safety friction device, which is adjustable to any predetermined value of the tow line pull.

The first impression may be gathered that these machines are somewhat complicated; but, considering their many functions and the great flexibility for performing them, the design is in reality peculiarly simple. The locomotives have fully demonstrated in actual operation that the requirements contemplated by the Engineers of the Isthmian Canal Commission have been successfully met.

The locomotives have a net weight of 86,300 pounds and a gross shipping weight of 92,500 pounds. They were mounted on specially designed skids and shipped from the General Electric Company's works at Schenectady by rail to New York, where they were loaded on board the ships as deck cargoes by means of a 125 ton floating derrick.

During the first three months of commercial operation of the Canal, from August 15 to November 15, the cargo transported through the Canal and towed through the locks by the locomotives amounted to 1,079,521 tons. During the fiscal year ending June 30, 1914, the Panama railroad carried 643,178 tons of through freight between the two seaboards, and in the preceding fiscal year 594,040 tons. From this it is seen that between six and seven times as much cargo is passing over the Isthmus now as passed over this route when goods were transhipped by rail.

The Lahontan dam constructed by the U. S. Reclamation Service for the Truckee-Carson project in Nevada is 1500 ft. long, has a top width of 20 ft.; bottom width, 600 ft.; height above river bed, 129 ft., and height above lowest point of cut-off, 220 ft. There are two spillways with a crest length of 250 ft. each, the top crest being 12 ft. below the top of the dam. The capacity of both spillways is 30,000 second-feet. The principal items in the construction of the dam comprised: Excavation, 350,000 cu. yd.; embankment, 750,000 cu. yd.; concrete, 70,000 cu. yds. The dam will impound a reservoir of 290,000 acre-feet., the reservoir being about 3 miles wide and 16 miles long.

A 25,000-volt submarine crossing of the Pacific Power & Light Company at Youngs River, Oregon, as described in the January Bulletin of the company, is part of a 25,000 volt line between Astoria and Flavel. The cable has a combination rubber and varnished cloth insulation. The three No. 2 conductors making up the cable with their insulation are formed into a circular cable by means of jute fillers, the whole being covered with a layer of black varnished cloth and finished with a well-lapped winding of rubber-faced tape. The cable is waterproofed with a lead sheath and then armored with a winding of No. 4 B. W. G. galvanized steel wires covered with a jute serving, having a sand and lime finish. The cable is more than three and one-half inches in diameter and weighs nearly 17,000 lb. per thousand feet. It requires one 500 foot length for the crossing, an extra length being provided for emergency purposes.

THE BEST CONTROL OF A PUBLIC UTILITY.

BY FRANK G. BAUM.

[Continued.]

Uniform Class Rates.

(4b) Uniform class rates for an electric light and power system or territory are advisable where one commission regulates rates.

The above applies where the rate must be fixed for a city, town or district. Where the rate regulation for the entire system or territory is in the hands of one body, much better results will be obtained by considering the system as a whole. I believe the necessity for uniform class rates is so great that I shall go into the matter in some detail.

Before the time of electric transmission the electric business was practically confined to the lighting business. In small towns the local steam plants supplying the lighting usually operated from about 5 p. m. to about midnight. In larger cities the plants operated during the entire 24 hours. Very little power business was done, with the result that the main business was done during the lighting hours.

None of these early electric companies were very prosperous, the main reason being the limited earnings due to the limited use of the plant, that is to the low load factor of the lighting business, usually from 10 per cent to 20 per cent.

With the advent of electric transmission from the water power plants the managers of these properties, seeing the investment idle or without load during most of the day, and interest and maintenance charges and operation costs being practically fixed independent of the load, began to look around for some business. Day load was sought and low rates had to be offered in order to induce the factories having steam engines to discard these and purchase electric motors and electric power. The success of the electric motor and electric transmission of power are responsible for the large economic gain obtained as a result of this change of the individual power plant to the universal electric power system.

It is the factory load that has made a financial success of electric transmission and I believe that the economic gain to the country due to electric power is only comparable to the gain as a result of railway transportation and the gain due to modern systems of agriculture. We have in California many communities which owe their beginning and development largely to electric transmission. It is, therefore, important that the reason for various costs of service on different classes of electric business under the conditions be thoroughly understood.

Under (4a) there was considered class rates applied to each city or district of a system. This method is necessary where the regulation of rates is controlled by local bodies, or a local company supplies the service. With the passage of the constitutional amendment placing all cities under the commission in California, a much more logical and satisfactory system of rates will result by considering rates for a given class for an entire system or territory for similar service. This will not only be more just to different classes of consumers, but immeasurably simpler in application and as will be shown it will stabelize and standardize the business.

In regulating rates for the different consumers in a city it has been found best and necessary to make uniform rates independent of the difference in cost due to different distances from the central station to the consumer. It has also been found advisable by the California commission (and I believe the principle necessary in practice under the conditions) to disregard the small variation in transmission costs and assume uniform power costs independent of distance from the power source. It is only a short step to a consideration of a uniform rate for similar class of service throughout a system or territory.

There are greater differences in cost of service in different sections of a single city for the same class of service than there are between cities of the same class in one large system. In a city the grocer and butcher do not vary charges by distance of delivery. That would breed all kinds of trouble. Similarly, electric service of a certain class should be standard throughout a city, even though the cost for energy and investment may vary 10 to 30 per cent. A uniform rate is essential for simplicity and to avoid any appearance of discrimination. Wherever the general rules for connections and service apply to a city the charge should be the same for the same class of service. Underground and overhead will have different schedules of charges and there will be different schedules for different classes of light service as well as different classes of power service.

It is believed to be as essential to carry this principle over the entire system. The overhead residence lighting service of towns throughout California, except perhaps the large cities like San Francisco and Los Angeles, is nearly enough the same to warrant a uniform rate. The same is true for other classes of service.

An examination of the load curve of a power system and a comparison of this curve with the load curves of the different substations shows at once that there is often no relation between the system load curve and the substation load curve. The reason is, of course, because the system load curve reflects at each time of day the characteristic demands of the system as a whole, while the local load curve measures only the characteristic of the particular town or industries being supplied by the substation. The two characteristics may be quite different.

If, however, instead of comparing the load at each substation with the system load curve, we analyze the system and the local load curves into "classes of service," we see at once an interesting and definite relation between the load curves of certain classes of business in all districts.

The characteristic loads on a large system may be segregated into several large classes; and if these classes of service are then present in any given town or supplied from any given substation it will be at once apparent. In Fig. 2 is given a characteristic "system" load curve and on the same figure is shown the load curve of certain classes of business. The principal classes of business on the system may be divided as follows:

Class 1. Residence and peak lighting. This load comes on the system, reaches peak and drops off again in all towns and cities at about the same time. This class of service extends over about six hours per day and the load curve is quite definite in character and practically the same over the entire system. The peak of the load curve (marked Class 1) covering about six hours shows this service. This service almost always determines not only the maximum peak load, but the time at which the peak occurs. The load factor can be predicted between 15 and 20 per cent.

Class 2. Commercial lighting and small power. If the system load curve is broken up into two curves, one representing the power and the other the lighting (marked lighting and power in figure), and if then from the lighting curve we take the residence and street lighting, the remainder may be called the commercial lighting. It will include day lighting and small motors on the lighting circuits, electric irons, cookers, etc. This curve (class 2) is also fairly definite for different towns.

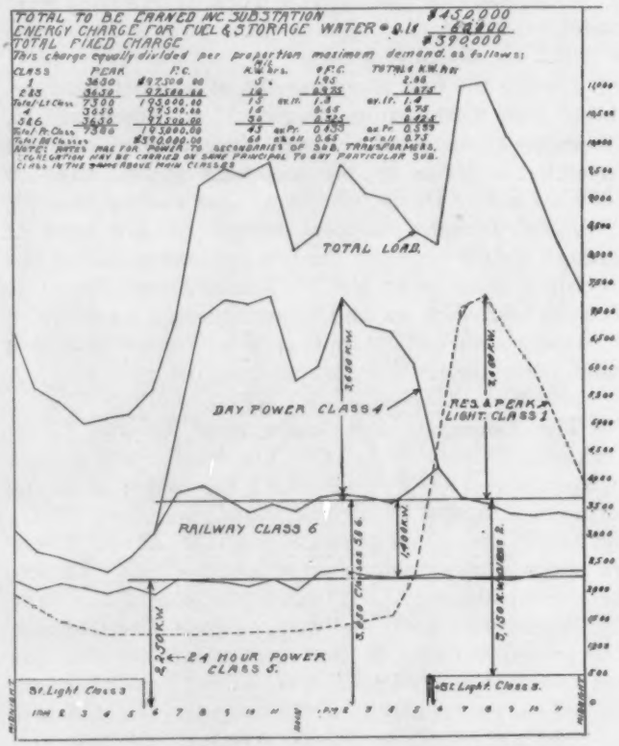


Fig. 2. Class Load Curves and Rates at Substation.

Class 3. Street lighting. This load has also a definite characteristic with modern installations and is quite uniform in different towns. This load can be easily measured directly and gives almost a constant load from dark to daylight. Class 3 is shown on bottom of figure.

Class 4. Day power. The system load curve, or the load curve of the power load, shows a very definite increase in load, starting about 6 a. m. and rising to a maximum about 10 a. m., dropping betwen 12 noon and 1 p. m., rising again to a maximum in the afternoon and dropping off about 6 p. m. This is the industrial power representing the motor loads in factories, machine shops, etc. The load is quite definite each day (excepting Sunday) and is as characteristic as the evening lighting peak. This load is shown by class 4 in the figure, load factor 30 to 40 per cent.

Class 5. Day and night power. This load represents the service to cement plants, dredgers, mines,

etc., and includes all those uses for which the load is quite constant. This load is shown by class 5 on the figure. The load factor may vary from 60 to 80 per cent.

Class 6. Railway power. This load curve is quite uniform for a general street railway system and can be determined easily, as usually the load is large and separate records are kept for this service. The load curve is shown and marked Class 6. The load factor is usually about 55 per cent.

Class 7. Irrigation. This load depends on the lack of rainfall and on the season of the year. And as these are fairly uniform over a large area, the load is characteristic of the season. This load covers usually the time from late spring to early fall and hence differs from the above six classes. This load, being generally on rural circuits, can be quite definitely determined. This load is generally required off peak. This load is seasonal and not shown on the figure.

Class 8. Reclamation. This load depends largely on rainfall, instead of the lack of it, as in the irrigation service, and hence this load partially, but not entirely, comes before the irrigation season. This load, like the irrigation load, is generally on rural circuits and can be quite definitely determined. This load is generally required to remain "off peak." This load is seasonal and is not shown in the figure.

Because irrigation and reclamation depend on the season, that is on the rainfall or the lack of it, it will be necessary to consider several years' records in order to determine the average of this service, because the returns will depend on the season.

Now let us go back to the total load curve and assume we have determined the load curve of the last two classes (that is irrigation and reclamation) and subtracted the same, for any given time, from the total load curve of the system, we then have a load curve such as shown by the heavy line in Fig. 2 representing the total load of the first six classes.

Now break this load curve into two curves, one representing the load of the classes 1, 2 and 3, residence, street and commercial lighting, and the others representing the load of the classes 4, 5 and 6, industrial, railway and twenty-four hour power. This gives us the curves shown on Figure 2 as light and power with the six classes shown. These curves are quite characteristic and very important relations are shown by these curves. We see at once we have an evening lighting peak in the lighting class and a day peak in the power class. General characteristics of the classes may be tabulated as follows:

Class.	Time.	Peak.	Load Factor.	
1. Residence and peak lighting	daily	7 p.m. to 8 p.m.	15 to 20%	Lighting class
2. Commercial lighting	daily	6 p.m. to 10 p.m.	30 to 50%	20 to 35%
3. Street lighting	daily	6 p.m. to 12 p.m.	30 to 50%	
4. Day power...work days		10 a.m. to 2 p.m.	30 to 40%	Power class
5. Day and night power	daily	8 a.m. to 6 p.m.	60 to 80%	45 to 70%
6. Railway power	daily	7 a.m. & 6 p.m.	50 to 55%	
7. Irrigation power	seasonal	10 a.m to 2 p.m.	10 to 15%	
8. Reclamation power	seasonal	6 a.m. to 6 p.m.	10 to 15%	

Note:—Overhead and underground service in some of these classes.

(Relative rates for service at substation for different classes shown in Fig. 2 and in Fig. 3 for varying energy charge.)

In Fig. 2 the relative rates for the four large classes are shown using 0.1c per kw.-hr. for the energy charge. In Fig. 3 the rates at the substation for the different classes of service are shown for varying energy charge. It will be noted that the total earnings are fixed. If this is **T** and the energy cost for the system is **E** then the demand charge is **T — E = D.** This demand charge **D** is then divided among the classes in proportion to the peak demand of the class, as shown on Fig. 2.

If we take out the cost of storage water (or its equivalent steam reserve) from a water power plant the remaining charges up to the substation are demand charges. It is scientific to proportion these demand charges between the classes in proportion to the peak demand of the class.

Energy charges **E** should be taken at the actual value as nearly as possible as business will develop best when normal conditions are assumed. In California where we store water for three to four months low water the energy charge will be about 0.1 to 0.15c per kw.-hr. as shown above.

Now the above are characteristics of the different classes of service wherever found and it is more logical to find the rates for an entire class over an entire system than to try to differentiate between the slightly different conditions in different cities. And as stated, much greater differences exist in the local towns than exist between different towns in the same general class.

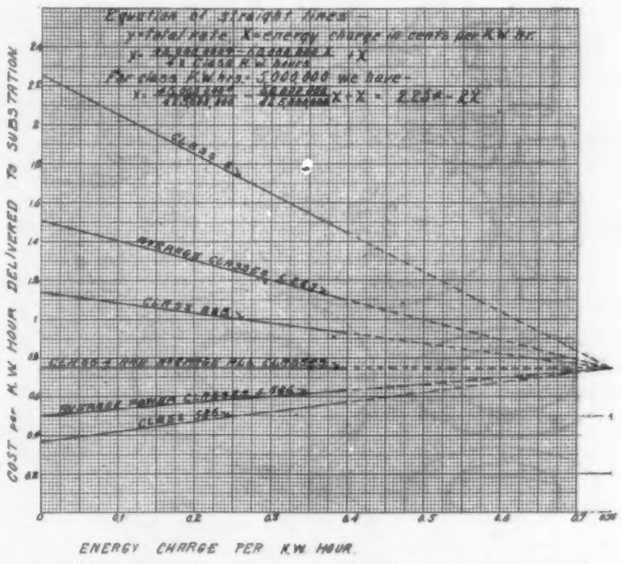


Fig. 3. Service Rates at Substation for Different Classes of Business for Varying Energy Charge.

Fig. 3 gives the rates for service to the different classes of business with total charges constant, but varying energy charge per kw.-hr. to suit different local conditions.

The general characteristics will, of course, differ to some extent for different localities. Different localities may have different industries which may be included in the above classes as power users or separate classes may be formed. For example, on some systems considerable oil pumping is done by electricity and this may form a class. Wherever the above classes of service appear in the system the characteristics of the class business will be practically the same.

[To be continued.]

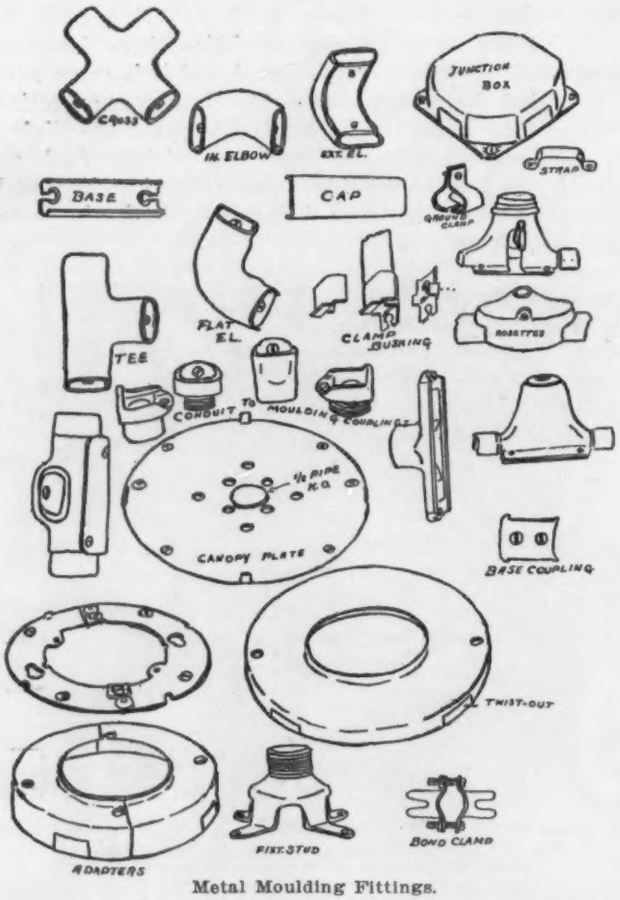
INSIDE WIRING METHODS

By JOHN CARRELL

Metal Moulding.

Metal moulding is used in completed buildings for exposed work; is very compact and neat in form, and is especially useful where concealed extensions to existing systems would be very expensive, and where appearance is a feature. The use of metal moulding is limited to circuits of 1320 watts or less, and to dry places.

The moulding is a wire-way in the form of a trough or channel just large enough to contain four No. 14 rubber covered wires, and consists of two parts, a base and cap, each made in one piece. The base forms three sides of the wire-way with edges arranged to hold the cap in position. The metal is treated to preclude rust and required to be .050 and .040 in.



Metal Moulding Fittings.

in thickness for the base and cap respectively. In order that the moulding may be branched or turned and continued in any direction, a set of fittings such as tees, crosses, flat elbows, internal and external elbows are provided.

Boxes used at outlets and junctions are of the same compact design as the moulding. They are used to attach receptacles, rosettes, switches, plugs and fixtures to the system; but fittings made to include receptacles, rosettes, etc., in their construction and design to be attached to the moulding system without boxes are largely used. Fittings used to form junctions with concealed wiring are a feature; split adapter plates and covers can be secured to outlet in use without the removal of fixtures and may be secured to unused outlet boxes by means of yokes and machine screws.

The workmanship on a moulding job is determined largely, as in conduit work, by the ground principle, i. e., to connect the system to an adjacent water-pipe, or equally secure ground, and to maintain this ground connection through all fittings. In order that this may be done, metal devices designed to be included in, or attached to the wire-way, are fitted with machine-screws. A slot is cut or punched in each moulding end and the end slipped under the head of a screw and clamped. The completed wire-way must be free from burrs or fins. Metal moulding is secured in place by means of screws or toggle bolts inserted through counter-sunk holes in the base or by small metal straps made to fit the contour of the moulding.

Continuous lengths of moulding may be carried through dry partitions at right angles to the vertical planes thereof; but must not otherwise be concealed. Where necessary to carry the system through a floor, the moulding is joined to a section of rigid conduit by means of a moulding to conduit coupling. This conduit is carried from a point three inches above the floor line to the ceiling below. In places where mechanical injury is especially probable the conduit is extended to a point five feet above the floor line.

The wire used is single braid, rubber covered, and is to be laid in the wire-way. Splices or taps are not to be made in the moulding or in crosses or tees, but only in outlet or junction boxes.

Estimating Costs.

The labor cost on a metal moulding job varies from forty to three hundred per cent of the cost of material. Most moulding jobs are of small size; are so called "jobbing work" and no two seem to be alike; or, even if the jobs be large, the conditions of the work make the counting of labor cost difficult.

Some of the variations in labor are due to the contractor. The first point of an efficient contractor in this class of work is to have the proper material and equipment on the job when the workmen arrive. Ability to have the right material in the right quantities at the right place at the right time is no mean capacity. To have proper step-ladders in first class condition on the work is also of importance. If a workman went on the premises without the necessary tools, or with broken ones, he would not receive much favorable comment from his employer; but to expect men to work to advantage without proper step ladders seems to be the contractor's prerogative.

Most estimators say that a set method of figuring labor cost for moulding work is not feasible; that averages are of little use because the variation of labor is too great; that on such work they make a memorandum of the several items desired by the customer or, if the job is large, an approximation of the material; but to count the labor cost they just size up the conditions of the work and give whatever price

their good judgment dictates. The price of labor on the larger jobs would be a percentage of the material cost; but they arrive at this percentage by merely contemplating the conditions of the work.

Now this "good judgment" is a mental act, and consists of either conscious or unconscious analogy and comparison; of dividing the proposed job and the conditions thereof into the component parts and perceiving how they agree or disagree with similar divisions of completed work. This mental act may be intuition insofar as it comprises a series of simple comparisons, and the faculty may reach a fair degree of maturity with much use; but to comprehend the items and conditions of the proposed job, the estimator must depend upon what his material senses have recorded in his memory from jobs actually installed. It is logical to assume that these remembrances would not be less useful if they were recorded in writing and would present this advantage: that they could be depended upon as up to date information, if properly classified, even if the conditions upon which they were based are forgotten.

A room is 50 ft. long and 20 ft. wide with ceilings 11 ft. high. The finish is metal lath and plaster without projections in the contour, 6 receptacles, spaced equal distances apart, were placed in a straight line on the ceiling. The circuit is fed from an existing outlet midway between two receptacles, making a total of 7 points wired to; 40 ft. of moulding was used. The time required was 4 hrs. If there had been 12 receptacles in two parallel rows, one row connected with a line of moulding running lengthwise, with room and the other receptacles each connected with sections of moulding running at right angles from the outlets of the first row, then there would be 13 points run to, and if 80 ft. of moulding were used the time should have been 7.7 hrs. or practically twice the time.

Assume that in the first case the 6 outlets in the ceiling were each controlled with a separate switch placed on wall opposite the outlets about four feet from the floor. The total amount of moulding would be 136 ft. and the number of points run to would be 19, i. e., 1 supply outlet, 6 receptacles, 6 switches and 6 elbows and the time required would be 12 hours.

The above figures are based on (1) the number of fittings, including outlet boxes, elbows, tees, etc., or the number of points which require the measuring and cutting of moulding, and (2) the number of feet of moulding. The numbers used in the proposition are:

$$\sqrt{\text{number of fittings} \times \text{number of ft. of moulding.}}$$

If a job executed under the most favorable conditions, is taken as a basis, and the proposed job compared thereto as to quantities, then a base price can be arrived at to which a certain percentage may be added for each condition liable to obstruct the work.

[To be continued.]

A public utilities commission for Utah is provided in a bill which has been introduced in the Utah Legislature by Frank Evans of Salt Lake City. The bill provides for a commission of three with jurisdiction over all public service companies and carries an appropriation of $36,000 annually to meet expenses.

LETTERS TO THE EDITOR.

Los Angeles Aqueduct Mistakes.

Stockton, Cal., Jan. 19, 1915.

Sir:—We note in the January 9th issue of the Journal of Electricity, Power and Gas an article on "Los Angeles Aqueduct Mistakes."

Your contributor, in his attack on municipally controlled operations, takes occasion to cite the experience of Los Angeles with the caterpillar tractor as an instance of inefficiency in municipal undertakings. He states: "A large number of expensive and heavy caterpillar traction engines were purchased for hauling freight with the result that the cost of handling freight was nearly doubled. This was an experiment, at which the mechanical engineers in the city scoffed, before it was tried. In spite of this and in the face of its certain failure, the city attempted it, and the newspapers were filled with statements of the wonderful saving it effected and praise of city officials who had suggested it. It only took a few months to show the impracticability of handling freight by this method, and the caterpillar engines were junked, after the city had sustained losses running into the hundreds of thousands of dollars."

Expensive, your contributor terms the caterpillar. Certainly he has never seen this tractor or he, being an engineer, would surely recognize that no machine could be built of as high grade materials and to so fine a standard, and sold at a lower price. Are we, then to accept his charge that the caterpillar is expensive, rather than the judgment of over 2000 satisfied owners, who have found this tractor worth every cent of its price?

Heavy, he calls it. We venture that not one owner out of a hundred could tell you the weight of his caterpillar. But they can all tell you this—that the caterpillar, on account of its long, wide track, that has eight times more ground bearing surface than round wheels, doesn't pack the ground, doesn't slip, doesn't mire. The weight is really not a matter of consequence, when it is considered that caterpillars are working in the Netherlands of California, in the delta lands of Oregon and in the Everglades region of Florida, where the ground is too soft even for horses. And weight wasn't a factor on the Los Angeles job, where a tractor was required that could haul through sand.

Then comes the wildest charge of all—that the caterpillar doubled the cost of hauling—caused a loss of hundreds of thousands of dollars.

Please refer to the official reports of the Bureau of the Los Angeles Aqueduct and read this from the report of November 30, 1908, and note that just the opposite is the truth:

"In the effort to reduce the cost of wagon haul below that of ordinary team transportation, trials have been made of traction engines of various design. It was found that the familiar types of engines with comparatively narrow wheel treads were useless in the deep dust and sand of desert roads. A special type, however, called the 'caterpillar' or 'paddle-wheel' engine—so designated from the peculiar construction of its rear and propelling wheels—has been placed in service with good results.

"The capacity of these engines naturally varies with the grade. Loads of from 15 to 20 tons are possible on level roads. Specially built trucks capable of carrying from 6 to

10 tons are used. Compressors, transformers and other heavy machinery, weighing from 7 to 10 tons, are easily transported over grades of loose sand ranging from 12 to 20 per cent, and around the sharp curves of mountain roads. Ordinary wagon transportation of such loads under like conditions would be an impossibility.

"Accurate cost data has been kept of the performance of these machines, together with team haul, for the purpose of comparison. Recent work in the Jawbone and Mojave sections shows an average ton mile cost of 20 cents for engine haul, against an average of from 40 cents to 50 cents for team transportation."

Read also this, from the report of July 1, 1909:

"Wagon haulage from the railroad has been greatly facilitated by the employment of traction engines of the 'caterpillar' type, a style peculiarly adapted to desert conditions. With a capacity of from five to fifteen tons, depending on the grade, these engines make regular trips to the various camps at an average ton mile cost of 25 cents. It is interesting to compare this figure with the lowest bid received for this work, namely, 80 cents per ton mile."

We invite you to correspond with the U. S. Department of Agriculture. In their files for 1909 will be found letters from the Los Angeles city engineer and from the contractor in charge of the hauling, stating that the caterpillar effected a big saving in this branch of the work, cutting the cost from 80 cents to 26 cents per ton mile.

One more charge—that the caterpillars had to be junked after a few months' service. As a matter of fact, the city figured in the begnning that it could afford to junk the caterpillars after they had served for a year, hauling at one-third the cost of horses. In spite of this, most of the machines were sold and some are still being operated successfully and profitably.

The full story of caterpillar successes would fill many volumes, but we believe enough has been told to show the injustice—the absolute inaccuracies—of your article.

We feel that we are entitled to a full and complete correction of the misstatements in your article which refer to the caterpillar, appreciating that it must be your policy at all times to treat fairly every subject presented in your journal and to publish only the truthful facts thereof and connected therewith.

We, therefore, call the matter of this publication in so far as it refers to the caterpillar, to your attention for your own investigation, expecting, of course, a retraction of the misstatements and erroneous facts recited in the article published.

Yours very truly,

THE HOLT MANUFACTURING CO.,

Stockton, Cal. By G. N. Walker,.

[This letter, as have been all others giving definite statements concerning accusations of inefficiency and mistakes in the construction of the Aqueduct, is published in the thought that it will tend to bring to light the truth in the matter and also to give engineers the benefit of the experience gained in building that project. A technical magazine, in its prime function as a mirror of engineering opinion, should ever endeavor to present both sides of a mooted question impartially. Certain charges have been made in these columns and equal space is available for the refutation of any or all of them.—The Editor.]

Superiority of Air Break Switch.

Sir:—The statements by Mr. Bowie in the stenographic report of the discussion on the report of the Committee on Inductive Interference, printed in your issue of January 16, 1915, are very much to the point and absolutely correct.

When I first became interested in oil switch and circuit breaker design about ten years ago, I found that there existed a nearly universal belief that oil switches were very much superior to air switches on account of the fact that they did not cause surging and abnormal voltages on the line, it being supposed that the air switch was particularly objectionable on this account. A strenuous attempt was made to find some authoritative source for this belief as it did not seem to be based on good theoretical grounds. No such authoritative source was ever found other than certain statements by a Dr. Steinmetz, which were made years ago, and which I do not believe were intended to have the universal application which has since been made of them. Careful tests of certain air switching devices did not show any such harmful results, and the experiments of some of the large eastern power companies with their switching devices seem to be very satisfactory. After visiting a large number of such power companies, and seeing certain home-made air break switches in operation, and after having made a number of quite conclusive tests myself, I came to the conclusion that there was absolutely nothing in the supposed destructive surging following the operation of air break switches. Theoretically there is no reason why such a surging should occur providing the switches are properly designed, and that they open the circuit in a reasonable length of time. In fact, theoretically considered, the air break switch is much superior to the oil break switch as it introduces a much more uniform resistance into the circuit than does the oil switch, and it seems reasonable to think that the way to open any circuit is to do it gradually through a resistance.

The principal objection to air break switches, from a manufacturer's standpoint, is that it is possible for operating engineers to design and build switches which are quite satisfactory. In other words, the average air break consists of standard line insulators and a little blacksmith work, and are generally special, being designed to suit some peculiar condition.

I quite agree with Mr. Bowie that the report is faulty in that it is making a definite recommendation on mere hearsay evidence that is not supported by any good authority. It is further objectionable in that it is theoretically incorrect and that it is opposed by a great mass of experience which is quite available to the commission.

I am not particularly interested in the manufacture of either oil break or air switches, and believe that they both have their field. I do not think that the air break switch has been properly exploited or used, and I am quite sure that for outdoor use, where plenty of space can be allowed, that the air break switch is both cheaper and more reliable than the oil switch if such air switch is properly designed. This is partic-

ularly true on voltages below 22,000 volts, where the insulation troubles are not especially serious.

I do not believe that the air break switch has a large field for interior work on high voltage, as the space taken up by the switching apparatus makes the buildings too expensive. Of late years there have been a number of very satisfactory air break switches developed, and I believe that the use of such switches will become much more general as further experience is gained in designing and using same.

Yours very truly,

Los Angeles, Cal. FORD W. HARRIS.

New Duties for Public Service Commissions.

Sir:—I wish to commend you on your position that at least one engineer should be on state utility commissions. There is probably no question in the minds of wide-awake engineers and others engaged in the electric power business that state commissions controlling them are here to stay. They should serve, and generally do serve, as judges between the requirements and desires of the public and the public service corporations. A public service commission is composed of human being of the same brand of clay as the rest of the human race, inspired by the same feelings and ambitions. One of these ambitions is to have great power, and the more corporations, the more power, under existing conditions. This power over corporations can be used beneficially or adversely to the industry or community. I believe there is no question in the mind of any one at the present day that unjust rulings against corporations will work, in the end, injuriously to the community, the industry and the commission, because of discouraging more developments.

When laws have once been passed discouraging an industry, it takes a long time for the people to realize it and change their views. For instance, we have no foreign sea transportation, owing to certain laws making it unprofitable. The public service corporations, being more in evidence in the daily life of the people, it is hardly likely that the public will allow anything to develop that will seriously interfere with the comforts and necessities furnished by public utilities, as they will make them either attractive to capital or furnish their own service.

The above conditions apply only, however, to those things the public is familiar with and wants. What will be the attitude of the commissions and the public toward new things? Would a body of men who thought they could put in a reliable and safe aeroplane service between San Francisco and Los Angeles be entitled to just 6 to 10 per cent dividends, or ought they to be allowed something for their risk? Many people will say that the possibility of doing such a thing is still in the distant future, but dreams have a way of materializing, in modern times, in an incredibly short time. Many imaginary difficulties are prophesied. When gas was first introduced in England, great objection was urged to its use, owing to the imagined danger of hot pipes. When it was being installed for use in the House of Parliament, rigid conditions were imposed. It had to be kept a certain distance from all inflammable material. After it was installed, the members would feel of the pipes and marvel at their not increasing in temperature. In the early days of operating ships by steam, some visionary dreamer stated the day would come when they would be driven over twenty miles per hour. A German professor wrote a book "proving" this was an impossibility, because the friction of the water would be so great that the heat inside the vessel would make it hazardous for men to operate if not actually burn the ship.

Probably the difficulties in the way of the imaginary aeroplane transportation company are as imaginary as the hot gas pipe and the internally heated by friction vessels. I believe, however, that public service commissions should try to look upon their work as being of a nature that should be constructive and encourage more developments. Their work can be made more constructive by seeing that investors in utilities are protected, as far as is humanly possible or advisable. Supervision of issues of securities is a good thing. It is not advisable for the commission, however, to prevent the development of a utility that would injure an established utility by rendering a superior and cheaper service by the discovery of new things.

Many European governments have hampered the introduction of the telephone, simply because they had money invested in their telegraph system. Many cities in England opposed the introduction of the electric light because they had an investment in a gas plant. None of the state commissions, however, have ever tried to prevent a new form of utility in a particular district, from operating.

The public service commissions of the Western states could help their states by advising Congress of their needs on the several proposed water power bills. Congress, as represented by its Eastern members, appears to be determined to prevent the development of manufacturing possibilities of the West by making water power developments unattractive. The West, generally speaking, probably has more water power developed than required for its immediate needs. No more will be developed by private capital unless they offer attractions. Therefore, the more restrictions thrown around water powers by the federal government, the less developments. I believe that our commissions can and will protect the interests of the people, therefore the federal government ought not to have any more rules and regulations regarding water power sites over which it claims control than to insure a legitimate and beneficial use.

The revocable permit now in force, certainly is no inducement to develop power sites. There are no doubt good arguments in favor of the revocable permit but I have not heard them. I should like to hear from some of your readers in sympathy with the revocable permit, arguments that could not, at the same time, be applied to farms, mines, etcetera, that the government is so willing to give a clear, unrevocable title to upon reasonable showings.

Respectfully,

F. O. BROILI.

Northwestern Electric Co., Portland, Ore.

INDUCTIVE INTERFERENCE.

(Here is presented the conclusion of the stenographic report of the discussion on the Report of the Committee on Inductive Interference to the Railroad Commission of California before the San Francisco Section of the American Institute of Electrical Engineers.—The Editor.)

A. H. Griswold: I do not care to answer specifically some of the questions that have been brought up. I think Mr. Ferris can answer them in closing. But there are a few things about the report that should be mentioned. It does not strike you as at all clear that it is made up by a body of engineers. In fact it is almost accidental that it was. At the original meeting there were about two lawyers to one engineer present; and among others was our general counsel, and he nearly fired me by suggesting to the commission that this committee consist of engineers and not lawyers. There is one thing in connection with this report that I want to bring out in particular. It does not represent everything that each one of us would desire. It is the result of a compromise, and it is the result of getting together, and attempting to bring about in the time limit that we had, as Mr. Babcock has said, the greatest good to the greatest number in the most reasonable manner. Now in doing that, we have learned of each other's troubles. The telephone engineers I am sure, prior to this study, were very unreasonable in their requirements of power men; and I think that the power men will agree with me—such of them as have worked with us on this committee—that they were likewise unreasonable in the matter of consideration of our troubles. In fact the development of the rule as we went along indicated that a lot of things that appeared to us offhand could be done were practically impossible in connection with practical power operation. Likewise the power men have learned a lot of our troubles, and have learned how they can be corrected.

Speaking of the "bat in the ear," we had a lot of trouble. We have it still. In that connection I have in mind one particular place where it was chronic. Not only were several operators injured, but two or three of our subscribers complained, and it was necessary for something to be done. So we sent an engineer to find out about it, and it developed that it was from a certain method of switching. The power engineer was inclined to think that it was absurd, so we set up the test and got him in there. We asked him to put a headset on and stay there, and have his men do the regular switching; in fact, it was the regular time when the switching was normally done each day. He kept the receiver on for the first operation; then he took it off and held it off here, and for the third operation (it seems there is a series of three) he threw it down on the test desk. He went over in the corner and sat down for about fifteen minutes, and as he went out, he said to the engineer, "Come over to my office in the morning." The engineer went over to his office in the morning, and he found a way to do that switching in a different manner that eliminated the trouble.

Now the thing that I want to bring out is this, that we have learned of each other's troubles by the study of this problem. We want all of you who are interested either in the power or the communication side, to know what these problems are and how to eliminate them. We want constructive criticism. We don't want destructive criticism. We want the things that will help us. We are bringing this report before you, and we brought it before the Spokane meeting, and it will be brought before the Los Angeles meeting shortly. We believe that the things that we have done are correct; but we are perfectly willing to be shown. If they are not correct, we want to know, and we will certainly correct them. We want to get out the best we can along this line, and I would like to see everyone take it in that spirit. The thing that we are asking is not the oppression of anyone or of any industry. It is the fact that we want these services to go along side by side, each of us to understand each others troubles, what they really are, and how to correct them.

J. P. Jollyman: I do not think that I can add very much in the way of information as to the consideration that led to the report of the committee. One of the members of the committee who is not here this evening made a remark at a recent meeting, which I think sheds a great deal of light on the subject as a whole, which was something to the effect we must all bear in mind that it is not feasible to run a boiler shop next door to a hospital. By that of course he meant, that the power circuits are the cause of the trouble; and the rules designed to reduce the trouble must necessarily be largely restrictive of the power companies. Judging from some of the comments which I have seen and heard, I think that some of the power interests, outside of the state particularly, have felt that their rights have been somewhat infringed upon. I do not believe that those men gave this matter the careful thought that it deserves. I think had they read the rules as carefully as they wrote letters of criticism to some of us, they might not have written as they did. The entire report was written with the utmost care and consideration. The exact meaning of every word and every phrase was carefully weighed before it was approved; and the fact that it was finally unanimously adopted by every engineer on the committee should show that there can be nothing fundamentally wrong with it. We do not claim for a minute that everything in it is absolutely correct. We started the entire report by saying that it was subject to revision, and to such correction as future study of the subject might bring forth. I think it would do all of us good to read the letter of transmittal after reading every third page of the report, and when finished go back and read the letter of transmittal and do not forget the point of view in which the report was presented.

Incidentally, as an illustration of the far reaching effects of interference, I would call your attention to the fact that wireless telegraphy is after all only a sort of inductive interference. When you realize that wireless telegraphy can be carried on over very great distances, with power transmission lines extending into the air only two or three hundred feet, you may begin to get some sort of comprehension of what long power lines of, say 100 miles in length, can do to parallel circuits which are only a few feet away. Of course the wireless employs a degree of power entirely different from ordinary power circuits; at the same time it operates over distances and can be detected at distances which are surprisingly large as compared with any distances between a power circuit and a parallel communication circuit. When you bear those facts in mind you can begin to realize what a power circuit can do to parallel communication circuit which is only a few feet away.

A. J. Bowie: I am heartily in sympathy with the sentiments expressed by Mr. Griswold that the committee should be fair in its treatment of this subject, and I realize that it is the desire of the committee to be entirely fair. I feel however that some matters, which I have stated before, should be subject to revision. I refer to the articles concerning switching.

With particular reference to Mr. Woodbridge's remarks, I will agree with Mr. Woodbridge that unquestionably we should not decide a case on a single instance or a single test. Mr. Woodbridge referred to the tests that I spoke of proving that the rise of voltage was greater with an oil switch than with an air switch. For your information I will state that the series of tests was most extensive. It comprised 275 tests, which are surely sufficient to justify the forming of a conclusive opinion. Certainly this is a more substantial basis

than the alleged "commonly recognized fact" where it was expressly avowed that no tests were made upon which to base a conclusion.

I have here an oscillograph curve of one of the tests, somewhat enlarged from the original, which shows what takes place when you are breaking an air switch. The upper curve gives the voltage in the circuit, and the lower curve gives the current.

There is a common misconception as to what takes place in an air switch on the breaking of a circuit. It is true that an air switch will take a great many cycles to break a circuit—possibly 100 under some conditions; but the conditions of unbalance exist for a very brief time; and there is absolutely nothing to show that with an air switch the condition of unbalance when one phase goes out before the other phase, is longer than with an oil switch. The first part of the stroke of opening an air switch consists of drawing an arc between the terminals. This arc is relatively short and of relatively low resistance, and makes no material effect in the current wave until the arc gets very much longer. Neither does it affect the voltage wave. The curve I am presenting shows that in the last six cycles of the opening of the circuit there is a gradual tapering off the current. That is very important in its effect on the action of the air switch. It accounts for the fact that air switches do not cause the rise of voltage which occurs with the oil switch. The reason is simply that the high resistance of the arc in an air switch cuts down very materially the current prior to the instant of break. That is one of the most helpful things in the operation of air switches not only on their own circuits, but also for their effect on neighboring circuits.

Mr. Woodbridge stated one matter I was very glad to hear, that there was absolutely no intention to discriminate against any type of switch. I feel therefore, as that should be the intention of the commission, that the rules should be amended so as to cover that intention. In reading from section 2 j, this section states: "The use of air switches on a power circuit involved in a parallel, is prohibited except for purposes of isolating sections of dead line, or for disconnecting transformers under load. This applies to the entire power system, any circuit of which is involved in a parallel, unless such switching is so remote as not to cause harmful transient disturbances in the communication circuits." How about disturbances caused by oil switches? Are they not to be included? They should have included any switches, and not have specified air switches.

A. H. Babcock: I make this offer to Mr. Bowie: Will Mr. Bowie come to a meeting of the Inductive Interference Committee and present his case. If we are doing him an injustice we will be very glad to recommend to the commission to change the rule; all we want to know is that we are wrong. We will be very glad to see Mr. Bowie at any meeting; we will make a meeting for him if he desires, and if we are wrong we will ask for a change in the rule.

The Chairman: You have heard Mr. Babcock's expression of the attitude of the committee, and it is certainly very fair. In closing I will call upon Mr. Ferris to answer some of the questions that have been asked if he has made a note of them.

L. P. Ferris: The hour is rather late, and I will only take a few minutes to cover a few points.

One gentleman asked as to the effect of climatic conditions—as to whether the particular climatic conditions under which these tests were made entered fundamentally into the results, in other words, if the tests were made at some other point, under different climatic conditions would the result be different?

In answer to that I will state that none of the tests, so far as I know, were fundamentally affected by the climatic conditions, so that fact does not enter in any way into the conclusions drawn from the tests.

Another gentleman asked whether static induction had been considered. Mr. Gray has already answered that point. I might say that a simple reading of the report will show that not only electrostatic induction, but electromagnetic induction, were considered separately and their effects together.

One point in regard to the use of oil and air switches. Mr. Bowie did not, I believe, consider the point Mr. Woodbridge made as to the time of opening an air switch; and in his last remarks stated that it had not been shown that the time interval between the opening of the switch and the breaking of the arc had anything to do with the duration of the unbalance. I think in the paper that you quote from—Mr. Hammond's paper—it is stated that an oil switch opens in a much less time than an air switch; I believe the oil switch opens perhaps in 1/240 of the time interval or 1/3000 of the time interval. An oil switch may open say in one-half cycle; and in that paper I believe the air switch opens in say 15/100 cycles as the upper limit. Now, as Mr. Woodbridge pointed out, it seems inconceivable that with that condition the duration of unbalance will not be greater with the air switch than with the oil switch; because the breaking of the arc is dependent upon atmospheric conditions. There is one case where it would depend upon atmospheric conditions, subject to wind and what not; and it is hard to conceive that all phases would break at the same instant or anywhere near as simultaneously as with an oil switch.

I was really interested to hear what Professor Ryan had to say in regard to the effect of auto transformers, and the possibilities of third harmonic introduced by such transformers. In the investigation of the committee the identical case or one similar to that which Professor Ryan mentioned was not encountered; but we can readily realize how under such conditions an auto transformer can induce a certain amount of third harmonic residual. That portion of the third harmonic naturally existing between the two lines would connect around a circuit above of the capacity to ground with the two lines in series, the earth connecting the two condensers. In that case it is hard though to believe that the amount of residual caused by that one particular transformer bank would be sufficient to render the circuit absolutely inoperative. But I do not know all the conditions which applied to that case, so I could not say as to the exact effect.

I think there are no other points, Mr. Chairman.

(A vote of thanks being carried to Mr. Ferris for his presentation of the report, the meeting adjourned.)

Trans-continental telephony has been made a reality with the completion of the line between San Francisco and New York, connection also being made with Boston, Washington and Florida. Conversations were carried on between Alexander Graham Bell and Thomas A. Watson, Theo. N. Vail and President Woodrow Wilson, as well as many other telephone and public officials.

A national electrical week was discussed at a representative meeting of electrical manufacturers, central stations, jobbers, contractors and dealers recently held at the offices of the Society for Electrical Development, which had suggested the idea. The week beginning October 18th was recommended and steps will be taken by the Society in co-operation with all electrical organizations, the intention being to promote the sale of electrical appliances, boost street lighting and conduct house wiring campaigns in every American city.

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CONTENTS

Panama Canal Electric Towing System 75

Lahonton Dam 79

25,000 Volt Submarine Crossing 79

The Best Control of a Public Utility 79

By Frank G. Baum.

Letters to the Editor 83, 84, 85

Superiority of Air Break Switch.
New Duties for Public Service Commissions.
Los Angeles Aqueduct Mistakes.

Inside Wiring Methods 82

A Public Utilities Commission for Utah 83

Inductive Interference Discussion 86

Transcontinental Telephony 87

A National Electrical Week 87

Editorials 88

Construction Criticism.
Developing the Corporation Soul.
The Value of Service.

Personals 90

Meeting Notices 91

Obituary 90

Trade Notes 92

Arrangements for the N. E. L. A. Convention 93

California Association of Electrical Contractors 93

News Notes 94

New Catalogues 93

Constructive Criticism

Great regret is felt among public utility men of California over the revelations concerning the connection of some members of the railroad commission with a get-rich-quick concern. Like Ceasar's wife a public utility commissioner must be above suspicion. It is believed that their association with the shady transactions of the International Mercantile and Bond Company was entirely innocent on the part of the commissioners and that their names were used as a lure for other investors without their authorization. It has long been the practice of the nefarious to cloak their unscrupulous schemes with the mantle of respectability borrowed from blameless public officials.

On the face of the affair it certainly does not seem consistent that commissioners should be receiving ten per cent return on private investment when they are limiting public enterprises to eight per cent on "the money which has been honestly and wisely invested." Better business judgment is expected from those who pass judgment upon the business methods of others.

Politicians are naturally making capital of these disclosures. Although they may in no way reflect upon the integrity of the individual commissioner, they undermine public confidence in an institution whose continued success must be governed by the science of being believed in. It is to be sincerely hoped that subsequent development in this unfortunate affair will restore public faith. So much good has already been accomplished by the commission that it should be allowed to continue its efforts unscorched by the breath of scandal. Final judgment should be withheld until all the facts are known.

Developing the Corporation Soul

The pyramids of Egypt typify a successful organization. Built up by years of patient self-sacrifice on a foundation of service, each stone supporting those above it and being supported by those below, its success depends upon the co-operation and loyalty of each individual employe to the men at the apex, whose lengthened shadow represents the organization.

Aside from this materialistic conception a public service corporation must have a soul, a conception of the rights of others in relation to its own rights. A generating plant, distribution system and a board of directors do not make an electric company. In addition there must be a social imagination, a sense of relative proportions, which represents the attitude of the company toward the public it serves.

A corporation's soul is the composite reflection of the hundreds of human souls of which it is composed. In this sense, organization can never replace individuality. The individual employe must forget his own ego and feel himself a member of the whole. He must learn the purpose and ideals of his leaders and conform his actions to them.

What doth it profit a corporation if it gain a monopoly and lose its own soul? Central station managers may set ideals for service, but their execution depend upon the individual. That is why the value of the individual is gaining new recognition and the

managers are trying to determine who among their workers are the ordinate, who the subordinate and who the insubordinate.

What is your place in the roll-call?

The Value of Service

Strong confirmation of the correctness of the "value of service" theory in rate-making is contained in Mr. Frank G. Baum's paper on "The Best Control of Public Utilities," now appearing in these columns. Heretofore there has been passive acceptance of the equity of this theory, but no rigid mathematical analysis which definitely proves its common-sense and clearly demonstrates its indispensability in the further development of the electrical industry. All this is done in such an easy, logical manner that some hasty readers may overlook its true significance while considering other features in Mr. Baum's paper.

His mode of procedure is to base average rates on the cost of service and from these to segregate class rates according to the value of the service.

The cost of delivering power to the substation bus-bar consists of two factors—demand charges and energy charges. The demand charge consists of such items as interest on invested capital, maintenance, depreciation, operation and management, all of which would continue even if no current were consumed. An electric plant must be ready at instant notice to meet the demands of any and all consumers. Consequently the demand charge is independent of the amount of energy delivered to the substation. The energy charge, according to the author, is what it costs to make power after the system is up to speed and voltage. Where fuel oil is available it is merely the oil and water bills. Fuel oil and boiler feed water are all that a steam plant requires after it is up to speed and voltage; lubricating oil and storage water is all that a hydroelectric plant requires. If the natural water flow is sufficient to operate the plant without stored water the energy charge is practically zero. Depreciation is less when the plants are operating than when idle.

As the earnings are known and the energy charge easily calculated, the demand charge is estimated as their difference, earnings minus energy charge equals demand charge. Dividing the total demand cost by the peak demand gives the average demand charge and dividing the total energy cost by the number of kilowatt-hours produced gives the average energy cost. The sum of these two averages gives the average cost of service.

But it is also necessary to consider the value of this service to different classes of consumers in order to give each class such a rate as will make it possible for the plants to earn the average rate. If every consumer were charged the same average rate many industries would be prohibited from using electric power on account of the competition of other kinds of power. Steam, gas and oil engines are keen competitors of the electric motor, and gas men are fighting the use of electricity for lighting and heating. No electric company can get more for its service than its competitors ask for an equivalent service. The value to the buyer is limited by the possibility of substitution. This brief statement epitomizes the entire gamut of utility, whether utility of form, place, time or use. It is the fundamental principle in central station business getting.

Furthermore low power rates make possble lower lighting rates by dividing the investment burden between them. No further argument is necessary to demonstrate that a diversified business is to the best interest of the consumer and community as well as the company.

Residence lighting, commercial lighting, daylight power and twenty-four hour power are the main classes of rate payers. In suggesting a simple method for determining how a class rate distinction should be drawn between them, Mr. Baum has performed a great service. An electric system represents a certain investment upon which dividends should be paid in order to create "an eagerness to serve." It is generally agreed, considering the risks of the enterprise, that about eight per cent is the lowest rate of return which will attract capital from other forms of investment competing with electrical securities. But because of the possibility of substitution of competing forms of power, it is impossible to supply power to certain classes at a rate which will give an eight per cent return on the investment tied up in that part of the equipment serving them. However, by assuming that one of these classes pays six per cent and the other ten per cent, the eight per cent average can be maintained and the final rate actually reduced for the ten per cent consumer.

Thus it is seen that Mr. Baum co-ordinates what have been generally considered two discordant theories. The commissions have favored the cost of service theory and the utilities have wanted rates figured on the value of the service. By giving due consideration to both it is possible to develop an equal eagerness to serve and to be served.

There are other interesting points in the paper, especially the idea of uniform class rates for an entire system or territory which will repay careful study. But on account of the failure of some to recognize the fact that Mr. Baum gave due consideration to the value of the service, it is deemed wise to emphasize this feature first. His method represents a materialization of the recommendations of the Rate Research Committee of the National Electric Light Association and is to be regarded as one of the most notable contributions to rate-making literature.

The task is but half completed, as the same study should be made of the situation between the substation and the consumers' meters. When this has been done and actual costs and values considered the first step will have been taken in putting order into the present chaos of rate making.

Attention has frequently been called in these columns to the fallacy of the "cost of service" theory in that it removes all incentives for efficient and economical construction and operation and places a premium on wasteful management. The value of service theory automatically introduces a factor of efficiency which leads to the best control of a public utility.

PERSONALS

F. H. Leggett, Pacific Coast manager Western Electric Company, is at Seattle.

F. N. Averill, Portland manager for the Fobes Supply Company, was a recent Seattle visitor.

J. L. Taylor was recently elected president of the Lone Oak Telephone Company of Stayton, Ore.

W. E. Hayes, electrical contractor of Santa Rosa, was a visitor at San Francisco during the week.

John W. Wilson has been elected president of the Osceola Telephone Company at Enumclaw, Wash.

J. W. Atkinson of Garfield, Wash., has been elected president of the Sky Rural Telephone Company.

P. H. Affolter of the Fairbanks-Morse Company, San Francisco, is making a business trip through Northern California.

A. B. Johnson of the San Francisco office of the Amerivan Ever-Ready Company visited Seattle on business recently.

F. A. Tittemore, manager of the T. C. Electric Company of Watsonville, Cal., was a visitor at San Francisco during the week.

A. B. Gray of Gray & Barasch, electrical contractors, Seattle, has returned from an extended trip through Eastern Washington.

C. E. Heise, manager of Westinghouse Electric and Manufacturing Company, San Francisco, has returned from a visit to Southern California.

Fred Hamilton, manager of the western division of the Mt. Whitney Light and Power Company, Visalia, Cal., recently spent a few days at San Francisco.

E. P. La Belle, with the B. C. Telephone Company, has been elected chairman of the Vancouver Section of the American Institute of Electrical Engineers.

Thomas E. Phipps has been appointed chief engineer for the Washington Public Service Commission, assuming office February 1st. He is succeeding **F. S. Burroughs.**

F. H. Murphy, illuminating engineer, Portland Railway, Light and Power Company has been confined to his home for the past two weeks with a severe attack of la grippe.

H. E. Sherman Jr., formerly salesman with the Crocker-Wheeler Company, San Francisco, will take charge of the Los Angeles office of the H. B. Squires Company February 1.

C. M. Yerger, for some time representative of the H. B. Squires Company, Los Angeles, has resigned his position with that company for the purpose of returning to his home in Cincinnati.

H. H. Cudmore, in charge of the Mazda Bureau of the General Electric Company at San Francisco, Cal., who has been East for the past several weeks, is expected to return about the first of February.

J. H. Sroupe, manager of the Portland office of Ne Page, McKinney & Company, has charge of the installation of an electric distribution system serving about 200 houses at Ridgefield, Wash.

M. C. Carhart, electrical engineer and Washington representative of the Alexander Hamilton Institute, returned recently from an extended trip through the East, visiting Chicago, New York and his former home in Wisconsin.

H. D. Pillsbury, vice-president; **J. C. Nowell,** general manager, and **A. H. Griswold,** plant engineer, for the Pacific Telephone & Telegraph Company, are inspecting plant and equipment in several cities in the Pacific Northwest.

P. M. Longan, comptroller of the Mt. Whitney Light and Power Company, Visalia, Cal., spent a few days at San Francisco during the week, en route East, where he expects to spend some time on business of the company he represents.

R. B. Mateer, formerly superintendent for the Southern Sierras Power Company at Hemet and San Jacinto, Cal., has been made commercial agent for the company at Riverside. **P. L. Nourse** succeeds Mr. Mateer at San Jacinto, which should adopt the slogan "a city of light" as a result of Mr. Mateer's efforts.

John P. Bell, who will succeed **A. B. Saurman** as Pacific Coast manager of the Standard Underground Cable Company, entered the employ of the company at Pittsburg, Pa., in 1896, where he has been located until transferred to the Pacific Coast. For the past eight years Mr. Bell has been the assistant secretary and treasurer of the company.

E. E. Stark, formerly electrical engineer for John Martin, and later for the Bay Counties Power Company at San Francisco, has been for some time engaged in the electrical fields of New Zealand. Word recently received at San Francisco indicates his appointment to the important position of city electrical engineer for the city of Christchurch, New Zealand.

Fred N. Wallace of Laidlaw, Oregon, has been appointed project engineer of the Tumalo Irrigation Project by the State Desert Land Board to succeed **O. Laurgaard,** resigned. The new appointment goes into effect February 1st. Mr. Laurgaard plans to take a trip East. The board adopted resolutions of appreciation of his work on the Tumalo Project.

John Montgomery, formerly with the Western Canada Power Company at Vancouver, British Columbia, has taken a position with the Utah Light & Traction Company as superintendent of their electric shop. Mr. Montgomery was formerly in the employ of the company as commercial agent and resigned to accept a responsible position with the Mexican Light & Power Company, in Mexico City, later transferring to the Western Canada Power Company.

C. R. Hunt, formerly with the General Electric Company at Chicago, is now Pacific Coast representative of Robbins & Myers of Springfield, Ill. Mr. Hunt is supervising the installation of large exhibits at the Panama-Pacific and Panama-California expositions, and at their conclusion will open permanent offices at San Francisco. He is well known to many Pacific Coast engineers on account of his early connection with the Independent Electric Plant at San Francisco and the Pacific Light & Power Company at Los Angeles.

C. B. Atichison, of the Oregon Railroad Commission, has been re-elected president of the Pacific Coast Association of Public Service Commissions. **Max Thelen,** president of the California Railroad Commission, was chosen vice-president, and **E. H. Walker,** secretary of the Nevada Commission, secretary. The organization is composed of the members of the Public Service Commissions of Oregon, Washington, California, Nevada and Idaho. It has been in existence for a couple of years and its purpose is primarily to give opportunity for concerted action on the part of the various commissions whenever such action is necessary.

A. B. Saurman, for the past twelve years Pacific Coast manager of the Standard Underground Cable Company, has been appointed southeastern manager of the company, with headquarters in his native city, Philadelphia, Pa., and will return East in the early spring. Mr. Saurman became associated with the company in Philadelphia in 1893 and after two and a half years in the construction department, was transferred to the eastern sales department at New York, leaving the position of assistant manager there in 1900, when he organized and was manager of the northeastern sales department, with headquarters at Boston, until transferred to San Francisco as Pecific Coast manager in the fall of 1902.

OBITUARY.

Milton D. Grosh, consulting electrical engineer at Salt Lake City, died at San Francisco on January 23d, prematurely cutting off a promising career. Mr. Grosh was a graduate of Stanford University in the class of 1895, having been especially prominent on the football team. He worked for a number of years with the General Electric Company and had recently been in consulting practice at Salt Lake City.

MEETING NOTICES.

Alameda County Electrical Development League.

The regular meeting of the Alameda County Electrical Development League will be held at the Saddle Rock Restaurant, 418 Thirteenth street, Oakland, on Saturday, January 30, at 1:15 p. m. Mr. G. R. Babcock, superintendent of the electrical department of the city of Oakland, will talk on "Fire Alarm Systems." All electrical men are invited to attend.

Los Angeles A. I. E. E. Section.

At the regular meeting of the section, held in the lecture hall of the Chamber of Commerce, on Tuesday, January 19, a paper on the Diesel engine was read by Prof. Adams of Throop College of Technology, profusely illustrated by lantern slides. A spirited discussion followed the reading of the paper, participated in by Messrs. Royer, Coble, Sessions and McGuire, some of whom took decided exception to the economics specified by the author. The meeting was presided over by Chairman Pyle.

Great Western Power Company Managers.

The annual meeting of the district managers of the Great Western Power Company was held at San Francisco and Oakland, January 19-22, under the direction of W. W. Briggs, general manager of the company. While in Oakland visits were made to several of the large industrial concerns to which the company supplies power and on Thursday evening the managers were entertained by F. H. Woodward, manager of the Oakland district, at a jinks in the Commercial Club. The party also viscited the hydroelectric plant at Las Plumas and upon returning to Sacramento were the guests of B. C. Hannon, district manager.

Spokane Engineering and Technical Association.

The engineers of the Inland Empire have organized the Spokane Engineering and Technical Association, a society which admits into its membership any person who is a member of any of the principal national technical societies. It is the aim to perfect this organization to such a degree that its influence will be felt throughout the Northwest, especially on matters pertaining to engineering questions. Engineers, by reason of their training and education, are better qualified than any other class of men for passing judgment upon any phase of work which might pertain to engineering as well as a great many other civic questions. Governor Alexander of Idaho has been requested to appoint an engineer on the Idaho Public Service Commission, and other constructive work is in contemplation. J. C. Ralston is president and C. F. Uhden, secretary of the association.

Utah Electric Club.

At the annual meeting of the Utah Electric Club, Thursday, January 21st, the following directors were elected to replace the five directors whose term expired: L. E. Brown, Westinghouse Electric & Manufacturing Company, Lloyd Garrison of the Utah Light & Traction Company, W. R. Armstrong of the Salt Lake & Utah Railroad Company, Julian Bamberger of the Salt Lake & Ogden Railroad Company, J. F. Derge, Utah Power & Light Company. The new board organized with the following officers: Wm. Scott, President, Utah Light & Traction Company; W. R. Armstrong, vice-president; L. E. Brown, secretary and treasurer. The talk of the day was given by Mr. John D. Spencer of the New York Life Insurance Company, his subject being "The Fourth Profession, Salesmanship." Mr. Spencer's most successful career in this field, together with his experience as a teacher of the subject amply qualifies him to handle it in a most interesting manner and one of the largest attendances of the year indicates his popularity as a speaker before the Electric Club.

Electrical Development and Jovian League.

The interest and enthusiasm which have marked the 1915 meetings of the Electrical Development and Jovian League of San Francisco were maintained at the meeting of January 20, when 93 were in attendance. President Fred B. Leggett opened the meeting, introducing T. C. Martin, executive secretary of the National Electric Light Association, and Geo. W. Elliott, master of transportation. Mr. Martin told of the plans for the N. E. L. A. convention at San Francisco in June. After the several committees' reports had been received, including the announcement that three new members had been received since the last meeting, Mr. Leggett turned the meeting over to Garnett Young, chairman of the day, who had provided a most enjoyable program of musical and monologuistic entertainment. With a few appropriate words of introduction. Mr. Young then introduced Mr. Chas. A. Vogelsang, who gave a most interesting and eloquent account of the great work that is being done at the Exposition. The meeting then adjourned after a hearty vote of thanks had been given to Mr. Vogelsang.

Jovian Electrical League of Southern California.

That the "pep" injected into the meetings by Tribune Peiper and the splendid programs prepared by the chairmen of the day from week to week, are thoroughly appreciated and enjoyed by the members, was evidenced again by an attendance of about 150 Jovians and their friends at the weekly luncheon at Christopher's on Wednesday, January 20, presided over by G. F. Kirkpatrick. Several letters congratulating the League on its progress were read by Tribune Pieper, who suggested the wearing of badges, showing the name of the member, so that neighbors at the tables might get acquainted. Failure to display the badge would be punishable by a fine of 10 cents, which is to be donated by the League to some charitable purpose. Excellent three-minute talks were given by Carl C. Young on H. W. Allen, T. Harvey Dukelow on Harry N. Sessions, and W. W. Cott on Harry W. Harrison. Accompanied by Sig. Ricardo Alterini, alias Dick Alter, two grand opera artists then entertained the members with a number of selections from well-known operas and the musical treat was greatly enjoyed. The speaker of the day was Chief of Police Sebastian, who talked to the League on "Perplexing Problems." He introduced his talk by stating that the police business, unlike other lines, is picking up. He laid stress on the co-operative spirit in the department and asked for the co-operation on the part of the citizens. He is anxious for a larger force so that crime may be prevented, which is more important than the detection of it. He regretted the laxity of the probation laws and remarked that seventy-five per cent of the criminals are juveniles. He advised the establishment of more night schools and playgrounds and the holding to stricter accountancy the parents of young offenders. He urged the giving of work to the unemployed, believing that a larger rock pile will decrease the number of vagrants.

Joint A. I. E. E. and N .E. L. A. Meeting at San Francisco.

A joint meeting of the San Francisco Section of the American Institute of Electrical Engineers and the Pacific Service Section of the National Electric Light Association was held in Native Sons' Hall, San Francisco, January 22, with an attendance of over 400 electrical men. The session was called to order by Stanley V. Walton, chairman of the N. E. L. A. Section, who first introduced Mr. John A. Britton. Mr. Britton, in welcoming the visitors to Pacific Service Section meeting, emphasized the power and influence of each individual in molding public opinion to a favorable attitude toward the public utility company. He spoke of the educational value of the Panama-Pacific International Exposition and told of the National Electric Light Convention to be held at San Francisco in June, in connection with which he introduced T. C. Martin and Geo. W. Elliott.

Mr. Martin as executive secretary of the N. E. L. A. and as senior past president of the A. I. E. E. expressed his satisfaction at the display of co-operation made manifest by this meeting, outlining the work of each organization. Mr. Elliott, as master of transportation for the N. E. L. A. convention,

detailed some of the plans for six special trains which will bring the delegates from the Atlantic seaboard.

The meeting was then turned over to C. J. Wilson, chairman of the local section of the Institute, who introduced the principal speaker of the evening, Mr. Frank G. Baum. Mr. Baum interpreted his paper on "The Best Control of Public Utilities" in an exceedingly interesting and instructive manner. His numerous side-lights on the subject, including a reference to the isolated plant as a "jitney" power plant, added greatly to an easy understanding of his able paper, which is printed elsewhere in these columns. After a brief discussion, the meeting was adjourned at a late hour.

San Francisco Jobbers and Contractors.

The second monthly meeting of the jobbers and contractors of San Francisco was held January 14th, with President C. F. Butte of the San Francisco Section presiding, and Geo. Sittman of the General Electric Construction Company, chairman of the evening. Mr. Sittman, in a few well chosen remarks explained the objects of these meetings, and then introduced W. A. Blair, treasurer of the Pacific States Electric Company. Mr. Blair spoke on the credit condition of the electrical contractor, stating that the electrical contractors of San Francisco compared favorably with those of any other part of the United States, but as a whole there was no worse credit risk than the electrical contractor. While he dwelt on the reason that 95 per cent of the electrical contractors were not successful, still he did not feel that it was entirely the fault of the contractor, but that the jobbers were responsible for a great deal of it. Mr. Blair stated that he believed that the present plan of the association was one that would succeed and that if the contractors would attend strictly to the business of building up the association that the day was not very far off when it would not be necessary to solicit members. When Mr. Blair had concluded the secretary was instructed to obtain a copy of the paper and send same to each of the members.

The next speaker was Mr. H. E. Long of the plant department of the Pacific Telephone & Telegraph Company, who gave a long and interesting talk on the requirements of the telephone company, and gave a very good idea of the specifications that would be published by the telephone company the latter part of January. Arrangements have been made by the secretary to furnish each member with a copy of these specifications.

The next speaker was R. D. Holabird, of the Holabird-Reynolds Electric Company, who spoke on "Co-operation." His remarks could be summed up in the following phrase: "Let each one of us know our own business and we are co-operating."

The next speaker was W. W. Briggs, manager of the Great Western Power Company. Mr. Briggs in his easy fluent manner proceeded to drive facts and figures into the minds of those assembled in a manner that they would not quickly forget. He left an impression on the electrical contractors of the necessity of each one of them boosting at all times for everything electrical, and do whatever they possibly could to correct in the minds of the thinking public anything that might be a detriment to the central stations.

Chief Barry of the department of electricity, was next introduced and gave a description of the new ordinance that would soon come before the board of supervisors. Everyone was well pleased with the manner in which Mr. Barry has taken hold of the situation, and it is needless to say that he will have the assistance of the contractors' association.

The next speaker was C. V. Schneider, president of the California Association of Electrical Contractors and Dealers, who expressed gratification at the attendance at this meeting, and promised that he would be at every one of them in the future.

Mr. W. L. Goodwin, vice-president and general sales manager of the Pacific States Electric Company, was then called on, and he took a well deserved slam at the contractors and jobbers who were so busy that they could not afford to spend the time to attend such meetings. He stated that the program that had been arranged for this meeting and the information given out by the various speakers was worth a great deal of money to every contractor and jobber in the business.

Secretary Hanbridge was then called on and he told briefly of the manner in which the Association was growing. The meeting was closed at 9:30 p. m. with a few remarks from Chairman Sittman inviting all to be present at the next monthy meeting, which will be held in Oakland during the quarterly meeting of the state association.

The following were present at the meeting. Representing:

Central stations: W. S. Briggs, manager Great Western Power Company.

Department of Electricity: J. M. Barry, chief.

Pacific Telephone & Telegraph Company: H. E. Long.

Jobbers: W. S. Berry, Western Electric Co.; M. S. Orrick, Western Electric Co.; N. C. Martinez, Western Electric Co.; E. A. Crowson, Western Electric Co.; R. D. Holabird, Holabird-Reynolds Elec. Co.; Chas. Hillis, Electric Appliance Co.; Chas. Wiggin, Dunham, Carrigan & Hayden; W. L. Goodwin, Pacific States Electric Co.; W. A. Blair, Pacific States Electric Co.; Geo. Drew, Pacific States Electric Co., Dave Harris, Pacific States Electric Co.

Contractors: C. V. Schneider, president State Association, Sacramento; M. E. Ryan, Redwood; J. Gensler, Oakland; L. B. Gilpin, Oakland; R. King, Oakland; Geo. Webber, Oakland; C. F. Butte, president San Francisco Section, San Francisco; Geo. Sittman, H. C. Hasselbach, A. H. Brainager, F. E. Hummel, W. D. Kohlwey, N. M. Hope, M. A. Delew, C. L. Chamblin, T. A. McDonald, Sam Hamilton, Frank Dody, W. S. Hanbridge, all of San Francisco.

TRADE NOTES.

The offices of the operating department of the Oro Electric Company, which heretofore have been located at Stockton, Cal., have been moved to the Sharon Building, San Francisco.

Ne Page, McKenny & Company, have just completed the electrical installation in the new offices of the Evening Telegram of Portland, as well as the printing department, which is electrically driven.

W. H. Smith Electric Company has the electrical contract for the remodeling of the Foster Hotel at Third and Davis streets, Portland, Oregon. The same contractor is installing the complete electrical installation for the new store of R. M. Gray on the southeast corner of West Park and Washington streets, Portland, Oregon.

The Portland Automobile Association will open its annual show on Saturday evening, January 23d, in the Armory, Portland, Oregon. This will be one of the most attractive exhibitions yet produced in Portland. The illumination will be all produced by an indirect system, produced by 307-40 watt Mazda lamps and 34 transparent domes with a 150 watt nitrogen unit in each. The complete electrical equipment has been installed by the Pierce-Tomlinson Electric Company, 286 Oak street, Portland, Oregon.

The American Telephone Fire Alarm Company have obtained the contracts for the installation of a 21 station fire alarm system in the plant of the Albers Milling Company in Portland, Oregon, and a 12 station system in the Crown Mill of the Balfour-Guthrie Company. The system in the Albers Mill is equipped with the special fire drill feature for the training and use of a private fire department. The above system is known as the Denio Fire Alarm System and operates over automatic telephone lines direct to the municipal fire department.

ARRANGEMENTS FOR N. E. L. A. CONVENTION.

T. C. Martin, executive secretary of the National Electric Light Association, and Geo. W. Elliott, master of transportation, were at San Francisco from January 18th to 23d, making arrangements and conferring with committees relative to the annual convention of the National Electric Light Association which is to be held at San Francisco in June. All details were investigated in providing five special trains direct from the Atlantic seaboard to the Pacific Coast and arrangements made for their reception at San Francisco. Plans were also made for similar trains from the Northwest and the South. The several trains will be routed so as to pass many features of engineering and scenic interest, including, hydroelectric plants, Yosemite Valley, the Grand Canyon, Mt. Shasta and the Yellowstone. One party will visit the exposition at San Diego.

Eight hundred rooms have been reserved at the leading hotels to accommodate the minimum of fifteen hundred delegates who are expected to attend the meeting. Adequate halls were rented in the Native Sons' Building, which will be the convention headquarters.

Monday, June 7th, will be registration day. In the evening the president's reception will be held in the ball room of the Hotel St. Francis.

Tuesday will be devoted entirely to business sessions, both morning and afternoon. The ladies will be entertained by a trip to Mt. Tamalpais and the Muir Woods, where luncheon will be served, and in the evening an official visit will be made to the zone at the Exposition.

Wednesday morning will be devoted to business, and in the afternoon the Exposition will be inspected, this being Electrical Day. The ladies will be entertained by a musicale and tea at the California Counties Building. The Public Policy meeting will be held in the evening and aside from the presentation of the committee's report will consist of an address by a prominent Californian. Invitations will be sent to prominent business men of the vicinity.

The concluding business sessions will be held on Thursday, with a Jovian rejuvenation and a vaudeville show given by the "Pacific Service N. E. L. A. Section" in the evening. The ladies will be entertained by an automobile trip to Crystal Springs Lake, where lunch will be served. Special entertainment for visiting delegates has also been provided for Friday and Saturday.

Messrs. Martin and Elliott were particularly impressed with the completeness of the plans which had been worked out by the General Conventions Committee of which John A. Britton is chairman; H. V. Carter, vice-chairman; Henry Bostwick, secretary, and W. W. Briggs, Geo. C. Holberton, F. H. Varney, T. E. Bibbins, W. F. Neiman, S. J. Lisberger, Carl Heise and A. H. Halloran are members, each in turn being chairman of a sub-committee. Mr. Martin and his staff will be on the ground in May to complete all details for what promises to be a most successful convention.

NEW CATALOGUES.

The General Electric Company has just issued Bulletin No. 49901, describing an Oil-Testing Set, by means of which the dielectric strength of oil can be easily determined. The proper use of this set insures the successful operation of high tension oil insulated apparatus. The set consists of a 30,000 volt testing transformer with an induction regulator for voltage control and an oil spark gap, all of which are assembled as a unit. The set can be furnished for either 25 or 60 cycles. Bulletin No. 44004 forms an ordering catalogue devoted to railway Line Material for Direct Suspension. This publication covers practically everything in line material for this method of suspension, save poles and wire. The parts are illustrated and each illustration is accompanied by the proper catalogue numbers. The prices are not included.

CALIFORNIA ASSOCIATION OF ELECTRICAL INSPECTORS

Section of N. A. E. I.

C. W. Mitchell, President. Arthur Kempston.
Wm. G. Pennycook, Vice-Pres. B. C. Hill, Executive Comm.
John W. Carrell, Secretary-Treasurer, 814 Scott, San Francisco.

The purpose of this organization is to standardize the common practice in electrical construction with the National Code as the general standard

Questions pertaining to electrical construction will be answered in these columns, but only from the point of view of the Code. This is a voluntary organization and the answers published under this heading must not be construed as authoritative, or binding. No attempt will be made to correllate the answer from the several Inspection Districts, as an occasional difference of opinion will tend to induce further study on subjects. All questions will be passed upon by an executive committee.

Address all communications to the secretary.

By the Secretary.

In the meeting of the C. A. E. I., held January 16th, in the San Francisco Department of Electricity, an interesting discussion took place on the cost of present methods of wiring. The feasibility of some so-called cheaper methods of wiring was considered, also.

On the point of whether present installation costs prohibited the use of electricity, one of the San Francisco inspectors related a condition of his district about as follows: In the group of hills which lie just to the east of the Mission Valley and overlook the Potrero, where the steep slopes present an effective natural barrier to street railways and where the pleasure seeker seldom strays, is a settlement of Slavonians. Here the former inhabitants of Southern Europe and of Russia have been transplanted to become good American citizens. The men are employed largely as laborers in nearby iron works, incinerators and factories, their wages varying from $1.60 to $3.00 per day. Nearly all own their homes. These are small cottages as a rule, but here and there a building of two or three flats testifies to especial thrift. The houses are equipped with many of the modern conveniences and, above all, many of them are lighted with electricity. With a few exceptions the houses were wired after completion, and this in face of the fact that electricity had to compete with kerosene and candles.

One job in this district was a one story five room cottage and was provided with four drop cords and one insulated chain pull socket all wired complete at a cost to the owner of $20. The job required 225 ft. of No. 14 wire and has a service of 2 No. 12 wires in ½ conduit. All the recommendations of the code were fulfilled, including the use of outlet boxes and a small metal cabinet for the service cut-out and switch. The tenant pays .08c per kilowatt for the current.

Attention was called to the methods of progressive contractors to secure business by accepting payment on the installment plan and to advertisements which state that five room flats in existing building will be wired and equipped with fixtures for from forty-five to fifty dollars.

On the subject of concentric or tube wire much speculation was indulged in as to how to prevent the overloading of such wire if used under American conditions. The tendency of house holders to place large fuses in lighting circuits or to copper fuses, especially when heating devices are used in connection therewith, is something that inspectors have so far been unable to check. This seems to be a serious objection to any system in which the bare conductor is laid directly against combustible material.

Another point on the use of tube wire discussed was regarding the effect of contact with the conductor and a piping system to which it was not electrically bonded. This comment was based on the fact that the difference of potential between grounded neutrals and piping systems often reaches ten volts.

NEWS NOTES

FINANCIAL.

PACIFIC GROVE, CAL.—At a meeting of bondholders of the Pacific Grove Railway Company a protective committee was chosen to investigate and recommend a course of future action, the Coast Valley Gas & Electric Company, the holding concern, having refused to make up further deficits in interest charges.

PAROWAN, UTAH.—Steps are being formulated here for the organization of a company for the purpose of building a new electric light and power plant. The town itself is unable to undertake the project, at this time, and it is planned to issue stock and construct the plant, then turn it over to the city when it is in a position to properly handle it.

GREEN RIVER, UTAH.—The city council is unable to agree upon the style of power plant to be installed here, bids for which were recently advertised. Two styles are favored by the council, one of the belt and gear driven system as submitted by the Green Construction Company, and the other a direct vertical plan, as submitted by the Allis-Chalmers Company is $16,000 and that of the Green Company $1300 lower. All bids have been rejected but these two, and a further discussion of the two bids is to be taken.

LOS ANGELES, CAL.—The City Council has adopted a resolution instructing the City Attorney to appear before the State Railroad Commission on the hearing of the application of the Nevada-California Power Company for authority to issue bonds secured by mortgages on their respective properties, and to protest against granting this permission on the ground that it would interfere wtih the aqueduct power project.

LINDSAY, CAL.—Stockholders of the Tulare County Power Company, at a meeting held here last week, decided to make a loan to the company sufficient to pay off all outstanding obligations. This loan will be made in three equal installments, one on the first day of February, one on the first day of July, and the third on the first day of February, 1916. A total of $65,000 cash was raised at the meeting to meet the first installment.

The company is composed of 418 ranchers, many of them large land owners. The company has been in operation two years and now has a connected load of 4400 horsepower, with 415 miles transmission and distribution lines, all within Tulare county, and operates 625 pumping plants. Electric current is also furnished to Lindsay, Tulare, Exeter, Tipton, Strathmore and Pixley. At the close of the meeting the following trustees were elected to pay over the money to Mr. Wrightman, who holds a mortgage loan for eastern parties; E. L. Daniels, Geo. Sill of Tulare, and R. F. List of Exeter.

BOISE, IDAHO.—The property of the Idaho-Oregon Light & Power Company was sold on January 18th to the Electric Investment Company, a Delaware concern organized for the purpose of purchasing the plant. The price paid was $2,005,000. The purchasing company is controlled by a group known as the minority bond holders which was organized by Mr. A. W. Priest, Appleton, Wis., who later secured a majority of the bonds of the Idaho-Oregon Company. The sale was made under the direction of R. M. McCracken, special master appointed by Judge Dietrich of the Federal Court. The purchase was made by Mr. O. O. Haga, representing the Electric Investment Company. The only opposing bidder was Mr. Niel A. Wethers who is said to represent the owners of the rival company in Boise. It is stated that the purchaser will proceed at once to improve the property and complete the Oxbow plant, which is expected to furnish most of the power, estimated at 30,000 horsepower which will be required to supply the needs of the company.

INCORPORATIONS.

PORTLAND, ORE.—The Oswego Lake Water, Light & Power Company has filed articles of incorporation. The purpose of the company is to furnish water to the city of Oswego and to install a power plant. It is incorporated by A. S. Pattullo, Fred H. Strong and Isaac D. Hunt, all of Portland, and is capitalized at $5000.

SAN FRANCISCO, CAL.—Nevada-California Electric Corporation, recently chartered under the laws of Delaware, has been organized primarily for the purpose of refinancing the Nevada-California Power Company, Southern Sierra Power Company, Corona Gas & Electric Company, Bishop Light & Power Company, Hillside Water Company, and the Interstate Telegraph Company. Eventually all the stock and bonds of these companies will be sold to the Nevada-California Power Corporation.

SAN BERNARDINO, CAL.—That the electric railway system known as the Crescent City Railroad Company, operating in San Bernardino and Riverside counties, will be given new financial aid and, probably, increased activities is shown by a dispatch from Sacramento which states that five residents of Oakland filed articles of incorporation for the Riverside, Rialto & Pacific Railroad Company of Riverside and San Bernardino counties and named San Francisco as the principal place of business. The company will operate the ten mile electric road from Riverside to Bloomington, thence to Rialto. The capital stock is fixed at $500,000, of which $10,000 has actually been subscribed by W. G. and Tyler Henshaw, Harry Chickering, William H. Metcalf and William Lees, all of Oakland.

ILLUMINATION.

BOISE, IDAHO.—The estimated cost of a lighting system for the south side is placed at $4639.30 by the city engineer.

FRESNO, CAL.—A resolution ordering and calling for bids on the proposed electrolier system for the city was passed and will be printed.

TUCSON, ARIZ.—Poles are being placed for the Nogales Electric Light, Ice & Water Company and its plant will be in operation within 30 days.

LOS ANGELES, CAL.—The Southern Pacific Railway has let the contract for the installation of lighting fixtures for the new depot, to the Meyberg Company of this city, for $10,000.

PASADENA, CAL.—Commissioner Allin of the department of public works has recommended that the desired ornamental lighting district on South Marengo avenue be granted.

SUSANVILLE, CAL.—Upon the application of H. H. Dunbar for a franchise to lay gas pipes for heat and power in this town, sealed bids for the same will be received up to March 8th.

ANAHEIM, CAL.—Work of installing an ornamental light system has been started here. The work is to cost $30,000 and will be divided between the city and the tax-payers. It is the first system of its kind in the county.

BAKER CITY, ORE.—The Oregon Lumber Company will install its own lighting plant in the immediate future, furnishing light for both the Oregon Lumber Company and the Sumpter Valley Railroad and for the Sumpter Valley machine shops.

TUCSON, ARIZ.—An electric light and power plant is to be put in at Casa Grande, Ariz., by F. H. Brackett, Colin Cameron and Frank H. Hitchcock of this city, if the necessary franchise is granted by the people of the town. The proposed plant will cost $100,000.

ROSWELL, N. M.—A petition is being circulated by property owners on Main street from Second to Fourth streets, which will ask the city council to allow them to install a boulevard lighting system. The plan is to place 8 poles to the block, with a cluster of three globes to the pole.

EL PASO, TEX.—Chas. O'Malley of the Las Vegas Light & Power Company is considering the matter of establishing an electric plant in Springer, N. M. The trustees of the town have been asked to donate a suitable piece of ground for a plant, and it is believed that necessary arrangements will soon be consummated.

PHOENIX, ARIZ.—It has almost been decided to use single standards in the lighting of Central avenue from the city limits on the north to the limits on the south. It is planned to use nitrogen lamps, developing about 600 candle power, placing two at each intersection of diagonal corners and two within each block.

TRANSMISSION.

TOPPENISH, WASH.—The Pacific Power and Light Company is planning considerable extension work in the territory surrounding this place.

WEAVERVILLE, CAL.—A franchise granting the right of erecting poles for the transmission of electricity in Trinity county has been awarded to the California-Oregon Power Company.

PORTLAND, ORE.—It is reported that 480,000 h.p. is possible at Celilo Falls, on the Columbia River, but that it would cost $50,000,000 for development purposes, making it impracticable for commercial purposes. Engineers under a co-operative contract with the state and federal governments recently investigated the matter.

LOS ANGELES, CAL.—The first steps have been taken in regard to the matter of acquiring by the city the electric light and power distributing system of the Southern California Edison Company. Data will be gathered regarding the value of the generating plant in Southern California, including the Kern River hydroelectric plant.

FALL RIVER MILLS, CAL.—The arrival of E. B. Bumsted, general manager of the San Francisco headquarters of the California Power & Maufacturing Company, is taken as an indication that the opening of spring will bring about a renewal of activity in construction work, which proceeded slower last fall than was anticipated. Bad weather forced them to suspend construction when the power lines had only reached McArthur, four miles distant. The latter place is now being served with electricity for lighting, the first time that electricity has been available in Fall River valley outside of the town of Fall River.

TRANSPORTATION.

SAN JOSE, CAL.—The district attorney has been requested to prepare a resolution offering for sale a franchise for a street railroad on Alum Rock.

SEATTLE, WASH.—At a conference called by A. L. Valentine, superintendent of public utilities, and which was attended by representatives of railways interested, it was decided to operate grades at Argo, Wash., by the construction of an 800-foot viaduct for traffic and street car purposes. The cost will be approximately $400,000.

SANTA BARBARA, CAL.—Application has been made to the city council by Richard Hamilton Gaud for a franchise granting the right to construct and operate a single or double track of street railway upon certain streets in this city, until March 15, 1957. The council will receive sealed bids up to February 18th for the franchise.

SEATTLE, WASH.—The city council of Seattle has voted to submit at the March election the ordinance of Councilman Erickson to extend Division A of the municipal street railway into Ballard, and the bill of Councilman Hesketh for the establishment of a municipal motor bus service between the south terminus of Division A and the Lake Burien line.

SACRAMENTO, CAL.—The new Northern Electric Railway is traversing North Sacramento. The construction on the line was commenced some months ago, and although it had been expected the road would be opened up the first of November, a number of unavoidable delays prevented the consummation of the work at any earlier period. The new trolley line follows the Northern Electric main line to a point between Globe and North Sacramento stations, and then turning eastward runs down Bassetlaw avenue across the heart of North Sacramento to the Swanson packing house.

SAN FRANCISCO, CAL.—Plan No. 9 for the Church street railroad has been submitted. It is a modification of Plan No. 5, and proposes to get over the hill by a detour through private property with a maximum grade of 9 per cent. It has the consent of nearly all the property owners. The city engineer explained that there was money enough in the bond fund to carry Plan No. 9 to Twenty-second street, but that it would require $101,000 additional to build the line to Thirtieth street, the terminal promised in the campaign for the bonds. As the supervisors have voted that there shall be no assessment of the district benefited, the question of where the additional $101,000 is to be found is still unanswered.

TELEPHONE AND TELEGRAPH.

McEWEN, ORE.—The contract for putting up the telephone wire from this place to Sumpter was awarded to Ray Edmiston recently.

BRAWLEY, CAL.—A wireless expert was in the Imperial Valley recently looking into the matter of establishing a wireless plant. The proposed plant would cost $2500.

SPOKANE BRIDGE, WASH.—The Interstate Telephone Exchange, located in the Spokane & Inland depot, has been dismantled as the company has discontinued business in this state.

LOS ANGELES, CAL.—The board of public utilities has approved the notice of sale for a franchise sought by the San Pedro Telephone Company, covering the Wilmington District.

ALAMEDA, CAL.—The Pacific Telephone & Telegraph Company last week, asked that its proposed franchise be granted as soon as possible. Action was postponed until the next meeting.

RIVERSIDE, WASH.—The People's Power & Telephone Company, Tonasket, will construct a telephone line between Riverside and Tonasket. A pole line with 6 in. tops will be used. It is probable that a party line will be constructed between Tonasket and Oroville. Work has been started on the line between Wauconda and Aeneas Valley, via Joe Hill ranch, to connect with the main line of the companies. The Loomis line is ready for service.

GRESHAM, ORE.—The annual report of the Multnomah & Clackamas County Mutual Telephone Company, shows the assets of the company $21,836.20. Receipts for the year beginning November 1, 1913, to December 31, 1914, were $12,990.35 from all sources. The income from telephones was $9747.74, which was the principal item. Many extensions were made at a total cost of $710.10 and new lines cost $102.75. The company now has 694 miles of wire, valued at $6940; 2989 poles, valued at $5978; 564 telephones, valued at $5986, and material on hand valued at $300. The lines take in practically all of Eastern Multnomah county and part of Eastern Clackamas county, including Gresham, Boring, Sandy, Fairview and Troutdale.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page opposite

A-1 **American Ever-Ready Works of National Carbon Co.**...
Los Angeles; 755 Folsom Street, San Francisco; Seattle.

B-1 **Baruch Electric Controller Corporation**.....
51 Grant Avenue, San Francisco; 424 13th St., Oakland.

B-2 **Benjamin Electric Manufacturing Co**.....
Rialto Bldg., San Francisco.

B-3 **Blake Signal and Manufacturing Co**.....
680 Howard Street, San Francisco.

B-5 **Bridgeport Brass Co**..... 4
(See Pierson, Roeding & Co.)

B-6 **Berkeley Electric Cooker Co**.....
1932 Center Street, Berkeley.

B-7 **Busch-Sulzer Bros.-Diesel Engine Co**..... 3
Rialto Bldg., San Francisco.

C-1 **Century Electric Co**.....12
614 South Grand Avenue, Los Angeles; 56 Natoma Street, San Francisco; Seattle; Spokane.

C-2 **Colonial Lamp Works**.....
444 Market Street, San Francisco.

C-3 **Crocker-Wheeler Co**.....
Title Insurance Bldg., Los Angeles; Salt Lake City; First National Bank Bldg., San Francisco; Seattle.

C-5 **Crouse, Hinds & Co**.....
Chicago, Ill.

C-4 **Cutler-Hammer Manufacturing Co**.....
579 Howard Street, San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-1 **D. & W. Fuse Co**.....
Western Electric Co.

D-2 **Dearborn Drug and Chemical Works**..... 4
355 East Second Street, Los Angeles; 301 Front Street, San Francisco.

E-1 **Edison Lamp Works of General Electric Co**..... 10
Rialto Bldg., San Francisco.

E-2 **Edison Storage Battery Supply Co**..... 4
441 Golden Gate Avenue, San Francisco.

E-3 **Electric Agencies Co**.....
247 Minna Street, San Francisco; Central Building, Los Angeles.

E-4 **Electric Storage Battery Co**.....
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; 118 New Montgomery Street, San Francisco; Colman Bldg., Seattle.

F-1 **Fairbanks, Morse & Co**..... 5
Los Angeles; Portland; 651 Mission Street, San Francisco; Seattle; Spokane.

F-2 **Fort Wayne Electric Works of G. E. Co**.....
Rialto Bldg., San Francisco; Colman Bldg., Seattle.

G-1 **General Electric Co**.....
124 W. Fourth Street, Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

H-1 **Habirshaw Wire Co**.....
(See Western Electric Company.)

H-2 **Hemingray Glass Co**..... 4
330 So. L. A. Street, Los Angeles; 345 Oak Street, Portland; 807 Mission Street, San Francisco.

H-4 **Holophane Works**.....
Aronson Bldg., San Francisco.

H-5 **Hunt, Mirk & Co**.....
141 Second Street, San Francisco.

H-6 **Hubbard & Co**.....
Rialto Bldg., San Francisco.

I-1 **Indiana Rubber and Insulated Wire Co**..... 3
Fobes Supply Co., Portland and Seattle.

K-1 **Kellogg Switchboard and Supply Co**.....
Aronson Bldg., San Francisco.

K-3 **Klein & Sons, Mathias**.....
579 Howard Street, San Francisco.

K-4 **K-P-F Electric Co**.....12
37 Stevenson Street, San Francisco.

L-1 **Leahy Manufacturing Co**..... 4
Eighth and Alameda Streets, Los Angeles.

L-2 **Locke Insulator Manufacturing Co**..... 4
(See Pierson, Roeding & Co.)

M-2 **McGlauflin Manufacturing Co**..... 4
Sunnyvale, Cal.

M-4 **Morse Chain Co**.....
Monadnock Bldg., San Francisco.

M-3 **Moore & Co., Charles C**..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 **Nason & Co., R. N**.....
151 Potrero Avenue, San Francisco.

N-2 **National Conduit & Cable Co., The**.....
Trust and Savings Bldg., Los Angeels; Rialto Bldg., San Francisco.

N-3 **National Lamp Works of G. E. Co**.....
(All Jobbers.)

N-4 **New York Insulated Wire Co**.....
629 Howard Street, San Francisco.

O-1 **Okonite Co. (The)**.....12
(All Jobbers.)

P-1 **Pacific Electric Manufacturing Co**.....
80 Tehama Street, San Francisco.

P-2 **Pacific States Electric Co**..... 2
236-240 So. L. A. Street, Los Angeles; 90 Seventh Street, Portland; 526 Thirteenth Street, Oakland; 575 Mission Street, San Francisco; 307 First Avenue, So., Seattle.

P-4 **Pelton Water Wheel Co**..... 4
2219 Harrison Street, San Francisco.

P-5 **Pierson, Roeding & Co**..... 4
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 **Pittsburgh Piping & Equipment Co**.....12
Monadnock Bldg., San Francisco.

S-1 **Schaw-Batcher Company, Pipe Works, The**.....
211 J Street, Sacramento; 356 Market Street, San Francisco.

S-2 **Simonds Machinery Co**.....
117-19-21 New Montgomery Street, San Francisco.

S-3 **Simplex Electric Heating Co**.....12
612 Howard Street, San Francisco.

S-4 **Southern Pacific Co**..... 5
Flood Bldg., San Francisco.

S-6 **Standard Underground Cable Co**.....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 **Thomas & Co., R**.....
(See Western Electric Co.)

V-1 **Van Emon Elevator Co**.....
56 Natoma Street, San Francisco.

W-1 **Wagner Electric Manufacturing Co**..... 3
Rialto Bldg., San Francisco.

W-2 **Western Electric Co**.....
8th and Santee Streets, Los Angeles; 507 Sixteenth Street, Oakland; 680 Folsom Street, San Francisco; 907 First Avenue, Seattle; 45 North Fifth Street, Portland, Ore.

W-4 **Westinghouse Electric and Manufacturing Co**..... 6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second Street, San Francisco; Second and Cherry Streets, Seattle; Paulsen Bldg., Spokane.

W-5 **Westinghouse Machine Co**.....
141 Second Street, San Francisco.

W-6 **Westinghouse Lamp Co**.....
(See Westinghouse Electric and Manufacturing Co.)

W-7 **Weston Electrical Instrument Co**.....
682 Mission Street, San Francisco.

W-8 **Western Pipe & Steel Co**.....
444 Market Street, San Francisco; 1758 North Broadway, Los Angeles.